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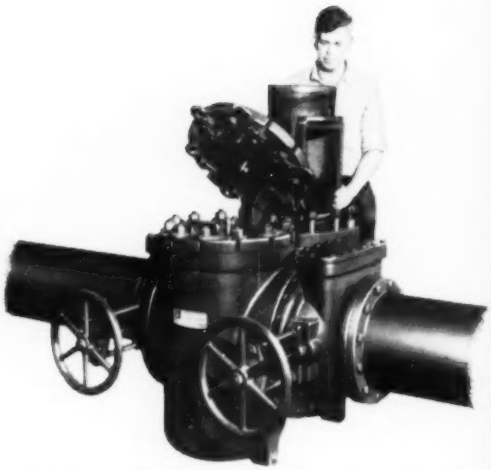
TYPE "V" TWIN STRAINER — Specially designed for lube oil, fuel oil, and viscous liquids. Available sizes 1" to 8" for 125, and 1½" to 10" for 300 and 500 psi. Straining baskets available with 1/64" to 3/16" mesh. Twin operation similar to Type "A" Strainer. Extra large straining baskets and unrestricted fluid passages insure maximum time between cleanings.



TYPE "A" TWIN STRAINER — For water and other liquids . . . available sizes 4" to 24" for 125 psi — 4" to 12" for 250 psi. Straining baskets available with 1/32" to 3/8" mesh. The twin feature offers two straining chambers in one body. By operating two valves, either chamber can be closed for removing and cleaning the basket at your convenience. With one chamber always available for service, you are assured continuous clear liquids.

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ARMSTRONG STEAM TRAPS

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ENGINEERS' PREVIEW

SOME TIME AGO, in *Engineer's Preview*, we told you about the proposal to build a pipeline for transporting coal over long distances. Now we learn that such a line has been successfully tested. The pipeline runs from Cadiz, Ohio to Lake Erie, over 100 miles. The coal is crushed fine, mixed with water and pumped through the line. The report is that the test line can deliver coal for $1 a ton less than the $2.75 a ton that it now costs to ship by rail.

* * *

FOR THOSE who need to use the ASTM standards in engineering work — and who doesn't? — the Society recently issued the 1952 index to ASTM standards superseding all previous indexes, which should be discarded. The index includes a list of titles in numerical sequence of all ASTM serial designations. For copies of the index write to the American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

* * *

PROBABLY the first commercial application of sunlight as a power source is in a clock recently made in Switzerland. Actually, the clock uses a four-day spring operated movement which is wound by a special electric motor, needing only 20 microwatts input, furnished by photo-electric cells. The permanent magnet motor weighs 45 grams, has platinum brushes and a gold commutator. The gear train used to increase the motor torque has a ratio of 1 to 35,000. Three hours of average illumination, either sunlight or artificial light, according to *The Ohmite News*, will wind the clock to run one day.

AFTER the somewhat hopeful article appearing in the January 1954 issue of POWER ENGINEERING told of the progress made in extracting germanium from fly ash, it is a little disturbing to note that another source of the material has been found — possibly more feasible commercially than fly ash. Dr. Hans Brauchli of The Johns Hopkins University has found, according to *Popular Mechanics*, that vegetation growing in germanium-rich areas, when reduced to ash, yielded as high as 5 per cent germanium (50,000 ppm). Compare this with the 530 ppm found in fly ash from a chain-grate furnace. The going price of germanium is $350 per lb. What next — germanium farms?

* * *

TVA THIRD generating unit has started commercial operation at the Fontana Dam, in western North Carolina. Its capacity of 67,500 kw has been added to the system, bringing hydro rated capacity to 3,406,935 kw. Work is proceeding also on four more hydro units, and construction is expected to start this fall on a fifth. The 18,000-kw unit at the Fort Patrick Henry Dam, in east Tennessee, is being tested now. These additional hydro units are under construction: A 26,000-kw unit at Douglas Dam in east Tennessee; a 10,000-kw unit at Chatuge Dam in western North Carolina; and a 59,500-kw unit at the Hiwassee Dam in western North Carolina. The 15,000-kw unit to be built in about six months, is at Nottely Dam, in north Georgia.

The Hiwassee Dam installation (POWER ENGINEERING, February 1953) is to be a pump-turbine unit, which functions as a centrifugal pump when rotated in one direction, and as a hydraulic turbine when rotated in the opposite direction. Both this unit, and the existing one at Hiwassee, will be operated to generate power during periods of peak loads on the TVA system. During off-peak periods, the pump-turbine will pump water back into the Hiwassee

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Subscription Information: Published monthly; price in the United States and its possessions $10, in Canada $11, in other countries $12 per year; single copies $1.00.

Micro film edition $4.75 annually from University Microfilms, Inc. Ann Arbor, Mich. All volumes since 1948.

Indexed in the Industrial Arts Index and the Engineering Index on file in public and many private libraries.

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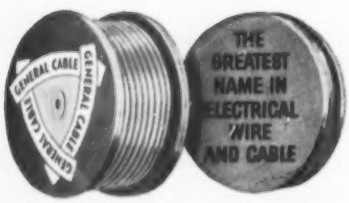

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For more data circle 503 on Post Card

Lake for use when peak loads next occur.

Extensive model tests for the unit have been in progress for many months at the Milwaukee plant of the Allis-Chalmers Mfg. Co. Tests have been completed satisfactorily, and manufacture of the unit has started. Present schedule is for the unit to start operating in autumn, 1955.

Meanwhile progress is being made on additional steam-electric units. First unit at the Kingston Steam Plant, east Tennessee, started commercial operation recently, two years and 10 months after first ground was broken for what it is believed will be the world's largest steam plant. The unit brought to 2,241,550 kw the rated steam capacity of the system. The capability of the first unit is 150,000 kw. Satisfactory construction progress is being made on 25 units in six steam plants: Widows Creek, two; Shawnee, six; Kingston, eight; Colbert, four; John Seviery, three; and Gallatin, two.

LETTERS TO THE EDITORS

Protecting the Hotel's Hot-Water System

I SHOULD LIKE to know how to protect metal in hot water heaters and hot water system and how to treat hot water in 1,000 gallon hot water tanks. There will be approximately 25,000 gallons of hot water per day used from this tank — *T. L. Beane, Little Rock, Ark.*

Editor's Note: — Mr. Beane is Engineer at the Albert Pike Hotel, Little Rock, Ark. We forwarded his letter to Mr. Jones, Research Engineer with an important power and light company, author of our present articles on paint, and on corrosion prevention. Following is his reply to Mr. Beane:

YOUR QUESTION on the protection of the inside surfaces of hot-water heater tanks is a tough one. I presume that you refer to regular hot-tap-water as used in hotels and homes for personal use, not for boiler feed, dish washing and sterilizing, or laundry work, all which require water in excess of 180° F.

My suggestions for maximum protection of personal hot water are:

1. Keep the temperature below 140° F. if you can. Increasing temperatures accelerates corrosion rapidly. I have always considered 140° F. as the critical temperature; above 180° F. I would recommend alloy tanks, Monel metal, etc., where feasible for long life.

2. Avoid retention of salts or ionizable chemicals left after softening water; these increase electric conductivity, and galvanic action.

3. Avoid aeration or dissolved oxygen in water if possible. If water used is a hard ground water, use hard water for a while to coat the inside of tank with some lime deposit to insulate metal of tank. Use of oxidation inhibitors might be harmful to persons and expensive.

4. If water contains dissolved CO_2 or carbonic acid, which are corrosive, addition of a little inexpensive lime-water by continuous suction or siphon arrangement from drums or solution tanks might prolong the life of the system.

5. The insertion of magnesium, zinc or other sacrificial metal rods will throw electrons toward the steel tank and reduce galvanic loss. For data on commercial types of Alnor or other protective rods, consult your local gas company. The company receives literature on these devices for home water heater protection.

6. Avoid the use of copper or brass pipe, rivets or contacts inside your system, as copper is noble to steel and will reduce the steel by galvanic action.

7. Clean the tanks of rust, etc. occasionally, which may remove causes of local pitting. Painting the inside of hot water tanks is fruitless for even silicone base paints will not resist hot water.

8. Don't expect too long life from hot water tanks in hotel or commercial use. The service is too rugged and what one can do to water used by human beings personally, even to drinking, limits chemical approaches. If you have sulphurous water, as often is found in Arkansas (Hot Springs), the use of sacrificial metals or rods may generate sulphurous gases that may be worse than corrosion to the welfare of your hotel.

I hope this helps you a little. I suggest you write to your National Hotel Association. In its meetings and references, this problem in hotels has been gone over frequently — *L. G. Jones, Dayton, Ohio.*

Figure Insulation Stud Heat Loss at the Outset

PAGE 74 OF your March issue moves me to report an experience that puzzled a group of us for some time. We were testing the insulating value of a new product, and our test results came out incredibly high. We finally did a bit of arithmetic and cleared up the difficulty. Here it is:

Consider a block of insulating material 12 inches square and x feet thick. Area = 1 sq ft.

Conductivity = 0.02 Btu/hr,ft², F/ft. The heat transmission will be

$$Q = \frac{kA\Delta t}{x} = 0.02\frac{\Delta t}{x} \text{ Btu/hr.}$$

Suppose that this block is held to the surface by a steel stud ¼ inch in diameter, as suggested by your illustrations on page 74. For the stud Area = 0.04909/144 = 0.00034 sq ft and conductivity = 25. The heat transmission will be $Q = 25 \times 0.00034 \frac{\Delta t}{x} = 0.0085 \frac{\Delta t}{x}$ Btu/hr.

The ¼-inch steel stud will transmit almost half as much heat as the entire square foot of insulating material.

If, therefore, one computes the expected heat loss on the basis of the insulating material alone, he may be sadly disillusioned when the final job is checked up. One should figure on the studs at the outset, and if their influence is too large, the job should be redesigned to minimize "through" metal, that is, studs, bolts, and even wires, that run from the underlying steel structure directly to the exposed outer surface — *C. Harold Berry, Cambridge, Mass.*

Mosquitoes? — Use Blue-Colored Paint

I HAVE NOTED the material on the utilization of color for identification of piping, steel stocks, gas bottles, etc., by L. G. Jones, in his articles on paints.

There is a sanitary function to color useful in power plant engineering with respect to control over insects. While I was in North Africa during World War II, I noted that the interiors of the larger more luxurious homes of Arabs had their interior walls painted in blue shades. I was informed by persons in the know that this color was insect repellent.

In the absence of screens and more modern means, this blue color served

to keep the population of mosquitoes at a minimum, a simple natural form of insect control. It adds no cost to installation and requires no maintenance or operating expense. Certainly the selection of blue as a color can be not only pleasant to the eyes, but also soft in general effect, and insect repellent at the same time.

However, quoting Modern Sanitation, August 1953, p. 55, researchers at the Color Research Laboratory of the Sun Chemical Company are now assembling data on the relation of color and insect attraction. It seems that they found that flies are generally attracted to light rather than dark colors. Color alone, at this time is not deemed a sure protection. — *C. W. Stevens, Dayton, Ohio*

How to Paint Those Chain-Link Fences

I HAVE BEEN advised by L. G. Jones of the Dayton Power and Light Company that one of your readers has expressed interest in the article, "What Does Painting Cost?" published last October in POWER ENGINEERING magazine.

With regard to painting chain-link fences, there are several methods commonly employed. The old hand brush and spray-painting methods are largely being discarded in favor of the newer methods of painting fences with rollers or with push brooms similar to those used for sweeping floors. Where rollers are used, a 12- to 15-in. roller is recommended, having a very heavy lamb's wool covering. It is suggested that the synthetic lamb's wool be used as this seems to wear better and does not catch quite so readily where the wires join and are rough. The natural lamb's wool wears out after about four hours use and becomes rather expensive. Such rollers are usually obtainable at local mill supply stores and are made by several companies in the United States.

When using rollers, it is suggested that a two-man crew be employed with possibly a third man to paint the pipes and to touch up misses and holidays which occur from the use of rollers. On one side of the fence, the man uses his roller very wet with paint, on the opposite side of the fence the roller is used almost dry and its purpose is to pick up excessive paint and to eliminate as many runs and sags as possible. With rollers it is difficult to get close to the pipes and other supports and brush painting is required as a follow-up to do these sections.

An even simpler method is to use the floor broom; the costs with this method are even less than with the rollers and the job is actually done a little better. When floor brooms are used, a two-man crew normally is used also *continued on page 110*

HERE'S WHAT THEY TELL US

PAN-AMERICAN OLYMPICS had just been held at the new stadium of the new University of Mexico, when **A. G. Gentle,** Atomic Energy of Canada Limited, was journeying back to Ottawa from the ASME meeting in Mexico City. Following his return to Canada he wrote:

> "Thought I might drop you a line, Mr. Earle, and maybe revive a glimmer of your trip and traveling with a fellow member. I trust your journey back was uneventful. There was a turmoil at the airport prior to my departure due to the Latin Americans returning from the sports — such noise, paper-wrapped gifts, and general confusion have I not seen before . . .
>
> "If you come across any trade journals related to nuclear energy, I would appreciate knowing about them."

All of our editors wished and *wished* they could have seen the excitement following the games in Mexico City!

Concerning trade journals related to nuclear energy, we asked — have you ever received our *Atomics?* If you're not getting it, we'll be glad to have it sent to you, without charge. (ASME pictures are in the May issue, page 90).

And speaking of atomic energy, and referring to Dr. Zinn's boiling-water reactor experiment reported in the March 29 issue of *Atomics*, **A. W. Anthony, Jr.**, president of the Pease, Anthony Equipment Co., asks:

> "How much water was expelled from the reactor in the experiment, Mr Kramer, and what happened after the water was expelled?"

Well, all details of the experiment have not been disclosed but presumably all the water either boiled away or was expelled from the reactor. This automatically reduced the reactivity of the reactor and the temperature dropped rapidly. The water, it must be remembered is not only the *coolant* but also the *moderator* and if the moderator disappears, as it did, the nuclear reaction ceases.

"You try to kiss me and you'll get the shock of your life!"

Craig Cain, Chicago Fly Ash Company, was glad he participated:

> "I wish to acknowledge receipt of the tear sheets concerning your article on fly ash. I sincerely wish to congratulate you on a very good article on the subject. I am very happy to say to others that I had a little to do with it."

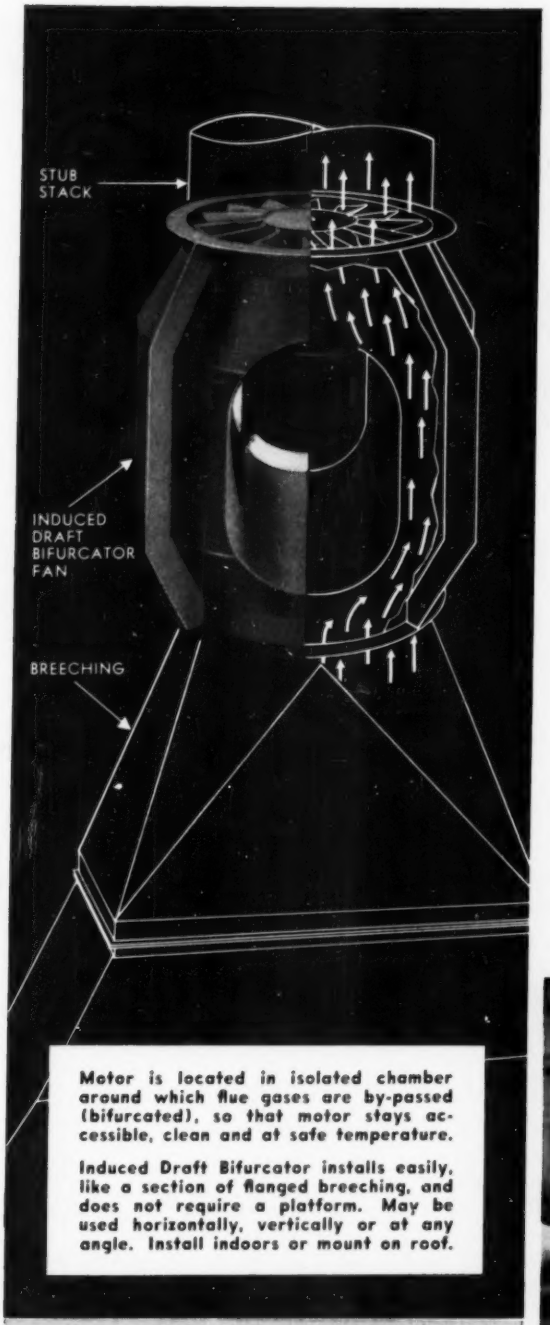
Mr. Cain was most helpful in supplying the marketing information for "Who'll Buy My Fly Ash?" (*April issue, page 70*). He is now preparing an article on the materials handling equipment required by fly ash customers. This should be exceedingly helpful in making *customers* of prospects.

From Oregon State College Library, **A. H. Priddy** said we were wrong when we omitted the serial number on the backbone of POWER ENGINEERING:

> "We have checked the volume numbering of POWER ENGINEERING and have noted the following irregularity —
>
> v. 57, no. 12; December 1953.
> Unnumbered; January 1954. (58th year)
> Unnumbered; February 1954. (58th year)
>
> "Do you plan to continue publishing POWER ENGINEERING without volume or number?
>
> "When we check in issues as they arrive in the Serials Department, the numbering tells us whether we have received all issues of a publication."

The information was omitted from our new cover design because a cross-section canvass of our readers indicated they were not particularly interested. Your letter convinced us, however, that such information is important in the case of libraries.

Both volume and issue numbers were reinstated on the cover beginning with the April issue. ***more on page 121***



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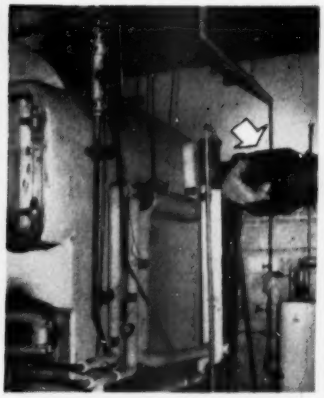

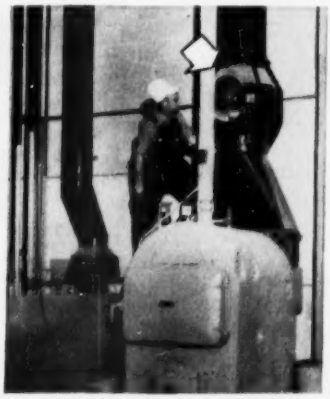

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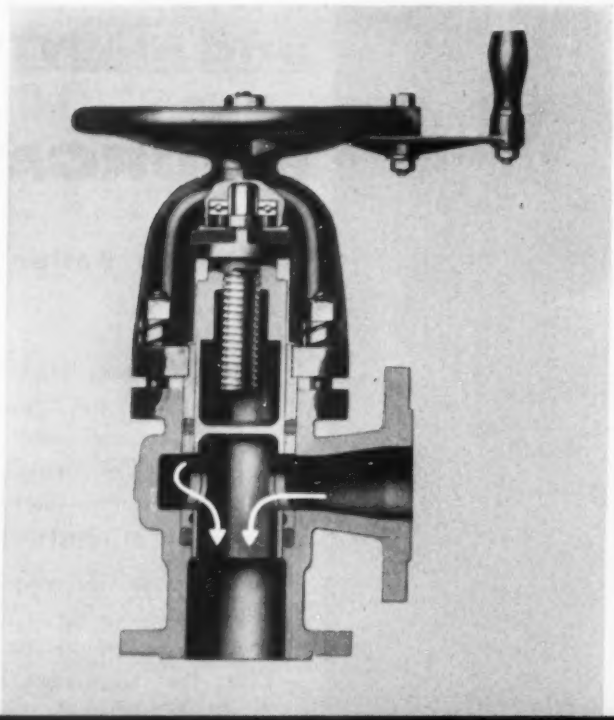

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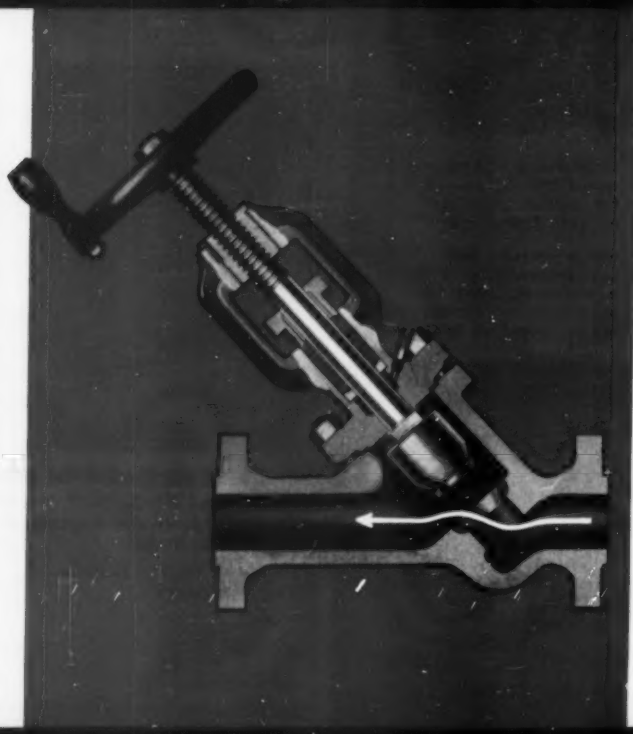

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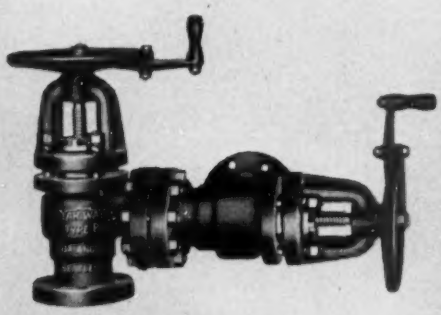
Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.

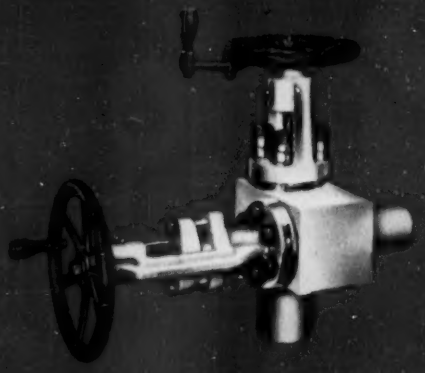


• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the sealing valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless seating valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

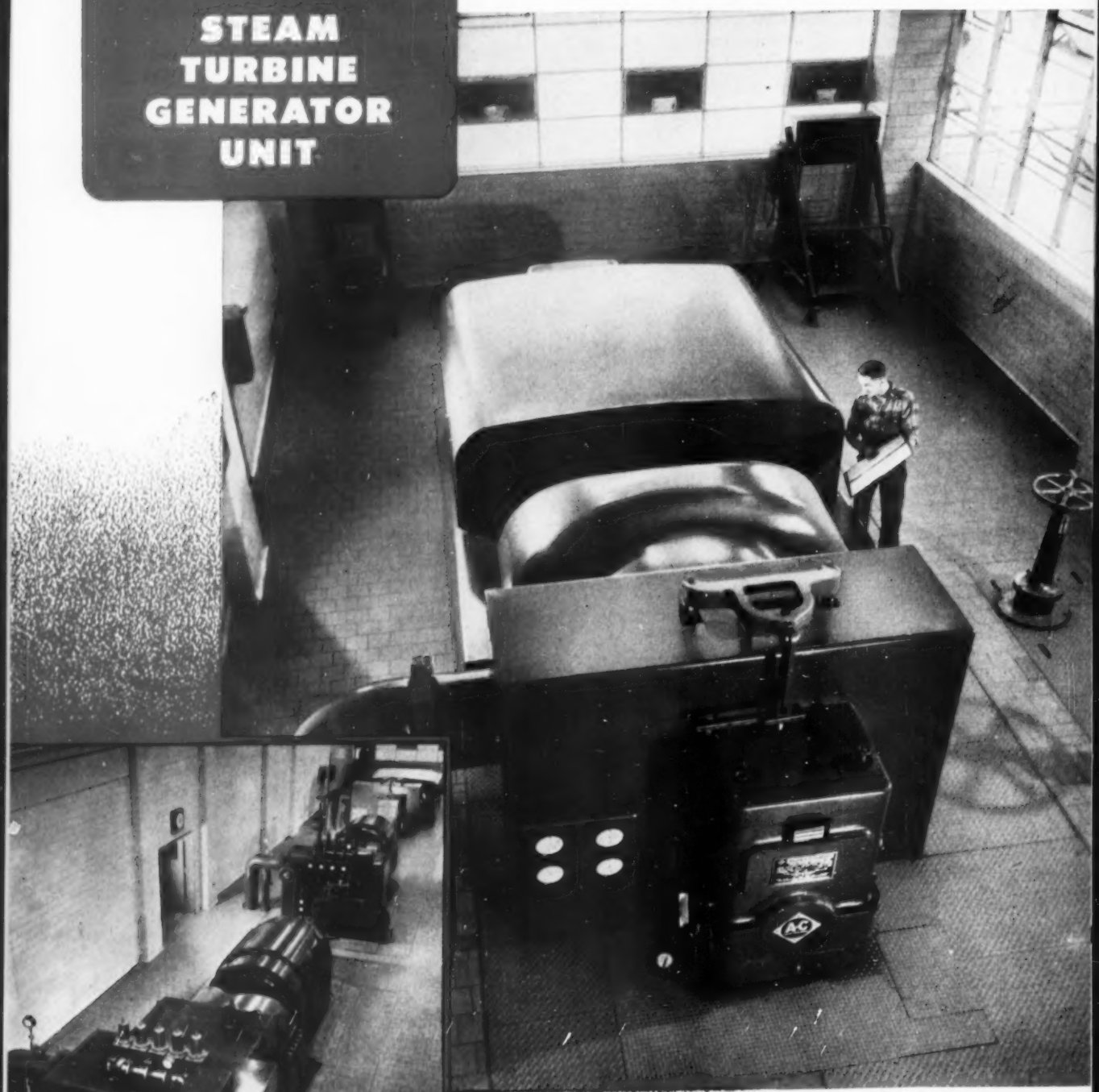
YARWAY

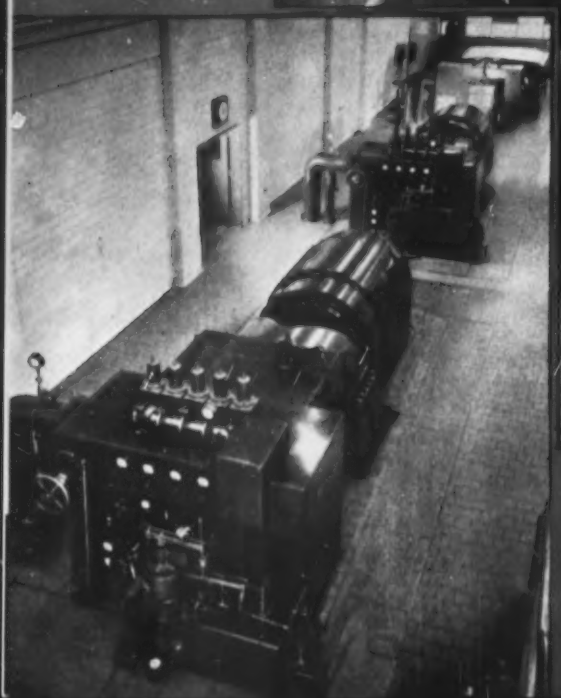
blow-off valves

Steam

WA-Series

STEAM TURBINE GENERATOR UNIT

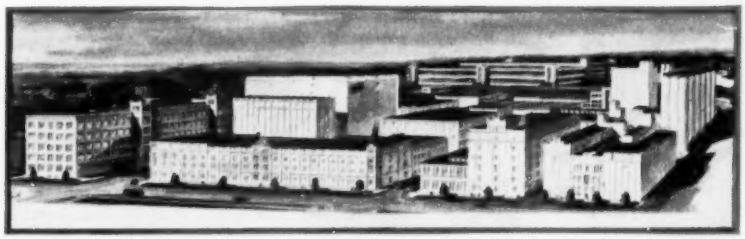




ALLIS-

Works Twice

FOR WORLD-FAMOUS BREWER



Jos. Schlitz
Brewing Company
Uses Steam for Both Processing
and Power Generation

Great quantities of steam are required for production of the "beer that made Milwaukee famous" at a rate exceeding six million barrels of beer a year. With so much steam needed for process, the electric power needed for plant operation is generated as a by-product.

At the Schlitz home plant in Milwaukee, two Allis-Chalmers 2500-kw, automatic extraction condensing turbine-generator units have been supplying process steam and electric power for the past five years. Recently, when more generating capacity was needed to match rapid plant expansion, Schlitz again turned to Allis-Chalmers.

Now operating 24 hours a day, 7 days a week, the new 5000-kw turbine-generator shown here was installed in the space originally planned for a third 2500-kw unit. It consists of a condensing, automatic extraction, impulse turbine and a housing type, air-cooled generator and exciter all carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA standard ratings 2000 kw and larger, the modern WA-Series unit is designed to meet modern power plant requirements. Bulletin 03B7654 gives complete details. For your copy, just call your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4269

WA-Series Features

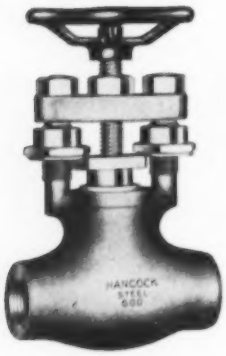
For easy installation and maintenance, every detail of the unit is designed for maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit that simplifies foundation requirements. Shipment of the turbine and the generator with their rotors in place further minimizes installation time.

Maximum reliability is assured by labyrinth spring-backed steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

CHALMERS

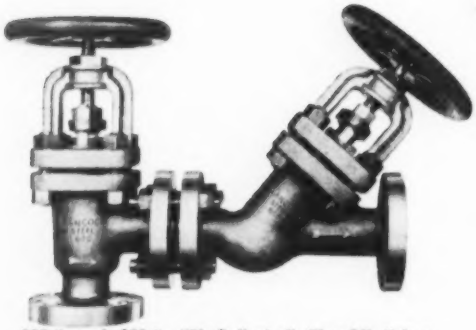
A-C ALLIS-CHALMERS

for the economy of quality...



600# Steel Valves. Dependable trouble-free in the severest services. **No Bonnet Joint Design. Sizes:** ¼" through 2". **Types:** Globe and Angle. **Connections:** Screwed, Socket Weld and Flanged Ends. **Service Ratings:** For **all** pressures up to 850 psi at 775° F. — O.W.G. 2000#, 100° F.

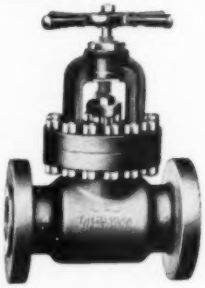
800# Steel Gate Valves. Do a job and stay on the job. **Sizes: No Bonnet Joint Design**—¼" through 2", **Bolted Bonnet Design**—¼" through 2". **Connections:** Screwed, Socket Weld and Flanged Ends. **Service Ratings:** For all pressures up to 800 psi at 775° F. — O.W.G. 2000#, 100° F.



300# and 600# "Bio-Deflector" Blow-Off Valves. Surpass all land and marine codes and insurance provisions. **Sizes:** 1½", 2" and 2½". **Types:** Straightway and Angle. **Connections:** 300# — Flanged or Screwed Ends; 600# — Flanged or Socket Weld Ends. **Pressures:** 300 psi, 800° F.—515# maximum boiler pressure; 600 psi—950# maximum boiler pressure.

1500# and 2500# Steel Blow-Off Valves. Superior in performance regardless of the demands of the installation. Weight and space savers. **No Bonnet Joint Design. Sizes:** 1", 1½", 2" and 2½". **Types:** Straightway and Angle. **Connections:** Socket Weld Ends standard. Flanged if required. **Pressures:** 1500 psi, 1050° F.—2080# maximum boiler pressure; 2500 psi—3120# maximum boiler pressure.

300# and 600# Cast Steel Valves. Installed in practically all power plants. **Sizes:** 2½" through 6". **Types:** Globe, Angle and Check. **Connections:** Flanged or Screwed Ends. **Service Ratings:** 300 psi, 800° F.—O.W.G. 600#, 100° F; 600 psi—O.W.G. 1200#, 100° F.



HANCOCK VALVES

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Take advantage of his knowledge and experience in selecting the right Hancock Valve for each service requirement. You can depend on him for prompt deliveries from local stocks.

specify HANCOCK VALVES

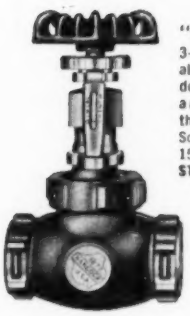
To get the most value from your valve investment, you must have the assurance of efficient, trouble-free performance.

Hancock Valves give you *economy of quality* that makes them your best buy in terms of long, reliable service. They have advanced construction and operational advantages found in no other valves—features backed by more than 75 years of pioneering new designs, new materials and new manufacturing techniques in anticipation of changing needs.

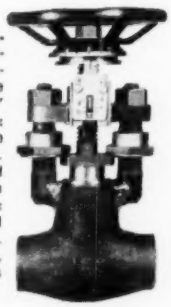
Rugged, precision-built Hancock Valves are noted for dependable tightness month after month under the most adverse conditions of use. They do a job and stay on the job—withstand the deteriorating effects of wire drawing, galling, steam cutting, erosion and corrosion far longer because they are functionally designed and made from carefully selected materials of the highest quality. Standardization of parts in all sizes of each type of valve provides the interchangeability factor so essential to simplified inventory and low-cost maintenance.

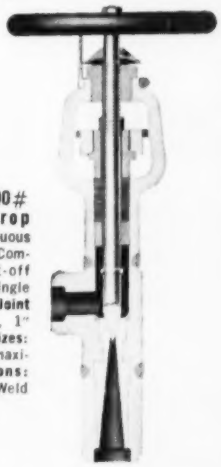
The operational perfection and extra service life engineered into all Hancock Valves are yours at the cost of ordinary valves. Whether you are adding new capacity to present facilities, planning a new plant or a revalve project, learn all the money-saving reasons why Hancock Valves belong in your specifications. Complete information is yours on request.

1500# and 2500# Steel Valves. The safest, most dependable shut-off valves obtainable. **No Bonnet Joint Design. Sizes:** ¼" through 2". **Types:** Globe and Angle. **Connections:** Socket Weld Ends standard. Flanged if required. **Service Ratings:** Up to 2500 psi, 1050° F. — O.W.G. 6000#, 100° F.



"Flocontrol" Valves. 3-in-1 design combines variable orifice, shut-off and index. **BRONZE: Types:** Globe and Angle. **Sizes:** ¼" through 2". **Connections:** Screwed Ends. Available in 150# and 300# series. **STEEL: Types:** Globe and Angle. **Sizes:** ¼" through 4". **Connections:** Screwed, Socket Weld and Flanged Ends. Available with 150#, 300# and 600# series flanges.





600# through 2500# Hi-Pressure Drop Valves. For continuous blowdown service. Combine orifice, shut-off and index in a single unit. **No Bonnet Joint Design. Sizes:** ¾", 1" and 1½". **Orifice Sizes:** ⅛" minimum, 1" maximum. **Connections:** Screwed or Socket Weld Ends.

When Hancocks go in, valve costs go down.

1877 HANCOCK U.S.A.

A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

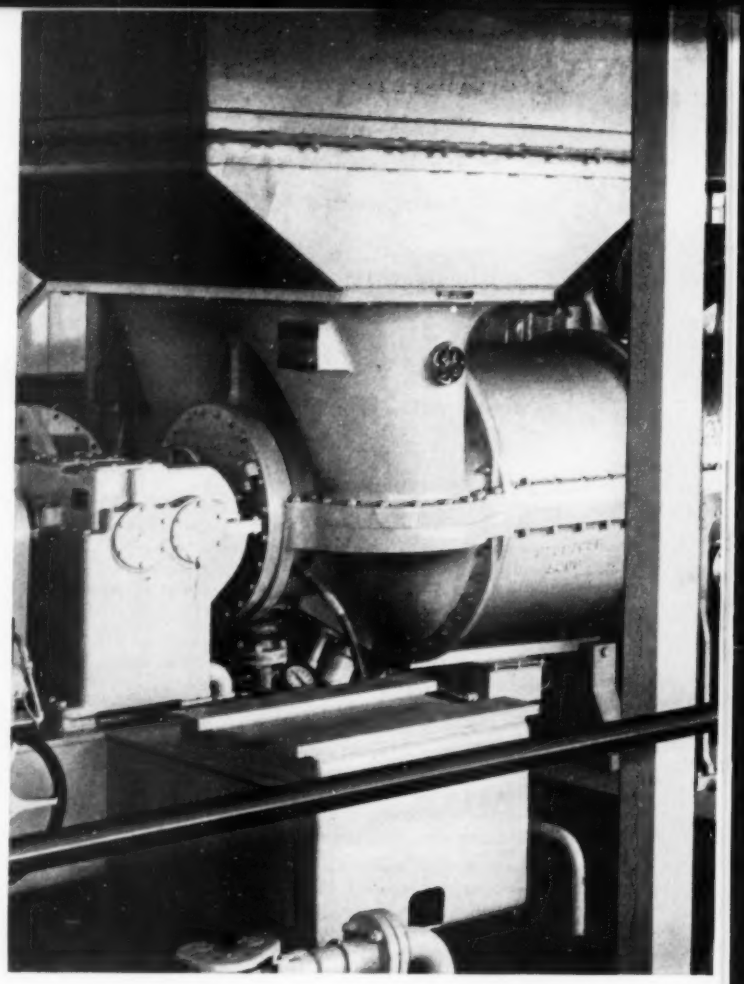
MAXWELL MANNING M&M & MOORE INC. TRADE MARK

For more data circle 507 on Post Card

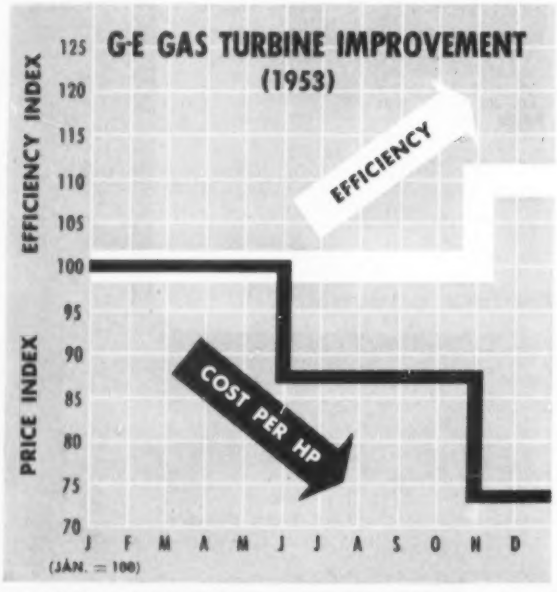
GAS TURBINE

progress report

In the past year, G-E engineers have reduced the cost per hp of the G-E gas turbine—and boosted its efficiency an average of 11 per cent. You may be able to put this versatile prime mover to work providing low-cost power for your plant.



Increased Efficiency, Versatility,



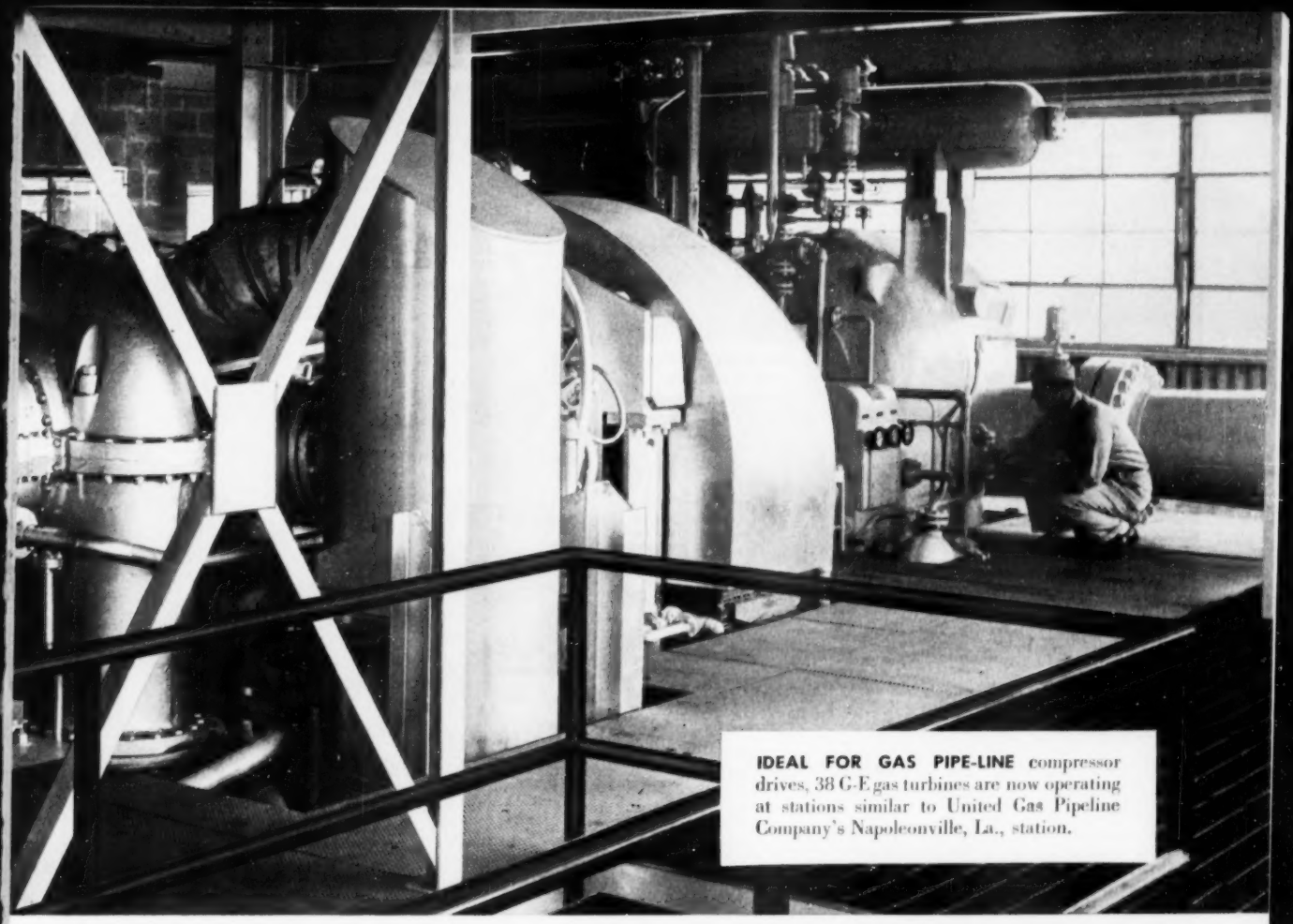
GREATER EFFICIENCY AND LOWER COST PER HP, achieved by improved design and manufacturing techniques, were significant G-E gas-turbine advances in 1953.

G-E GAS TURBINE OPERATING RECORD

(As of March 15, 1954)

TYPE OF SERVICE	NO. OF UNITS	OPERATING HOURS
LOCOMOTIVES	11	60,000
POWER GENERATION	16	70,000
GAS PIPE-LINE PUMPING	38	150,000
PETRO-CHEMICAL	1	3,000
TOTAL	66	283,000

UNEQUALED RECORD for operating hours and diversity of application, shows versatility and dependability of G-E gas turbine, gives G-E engineers vital data for future progress.



IDEAL FOR GAS PIPE-LINE compressor drives, 38 G-E gas turbines are now operating at stations similar to United Gas Pipeline Company's Napoleonville, La., station.

Lower Cost Per Horsepower Mark G-E Gas-turbine Progress

In less than five years, what was a completely new, un-tried prime mover has been shaped into a dependable, economical means of power. Already G-E gas turbines have racked up over 280,000 hours driving railroad locomotives, generating electric power, and turning high-speed compressors for gas pipe-line pumping and other industrial processes.

In the past year alone, G-E engineers have reduced the cost per horsepower for the gas turbines an average of 26 per cent. In the same short span, they have boosted efficiency an average of 11 per cent.

Outstanding among recent improvements is an integral base on which the turbine and its auxiliary equipment are permanently mounted and shipped substantially reducing installation costs.

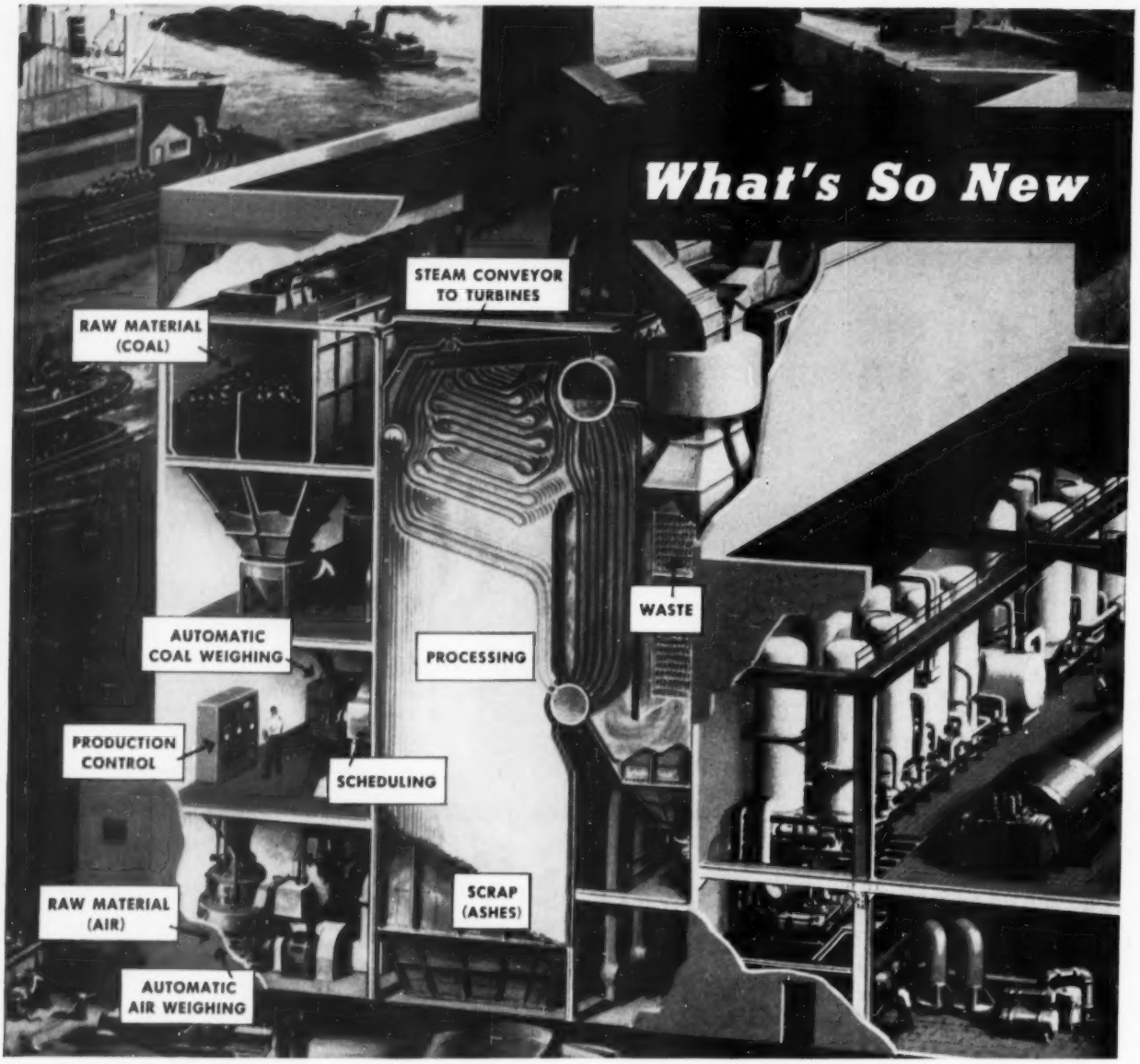
How could all this happen? General Electric, leader in the design and manufacture of both steam turbines and jet engines, was well equipped to develop the combustion gas turbine. Now, with thousands of hours of operating experience already accumulated, and with a factory designed exclusively for their manufacture, G.E. is leading the way in the gas turbine field.

If you would like more information on the gas turbine, contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Section 255-10, Schenectady 5, New York.

Progress is our most important product

GENERAL ELECTRIC

For more data circle 508 on Post Card



View Courtesy of the Armstrong Cork Company

This Is How a Factory Man Might Look at a Power Plant

That's because, in most plants, it's a completely automatic manufacturing operation, converting fuel and air into available heat and condensate and make-up water into steam for processes and turbine generators. Instruments and controls make it possible to achieve the full efficiency that has been built into the modern power plant.

REPUBLIC FLOW METERS CO.

About Automatic Factories?

. . . Power "Factories" Have Been Operated Automatically for Years!

THEY say it's coming — automatic production of automobiles, appliances and the thousands of other things we need and use. It's a startling thought, this idea of factories that will need only human supervision and maintenance and nothing more.

Yet, when you look at your own power plant, the idea doesn't seem so new after all. For power plants are actually factories. They produce products — steam and electricity — that are distributed, sold and used by millions daily.

PIONEERS OF AUTOMATIC FACTORIES

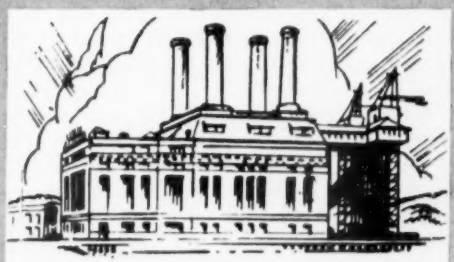
It is the power industry that has actually pioneered automatic factories. Almost 30 years ago the first power plant was operated entirely by automatic controls. Control principles learned from this and thousands of subsequent installations are guiding today's designers of the factories of tomorrow.

The Smoot Engineering Corporation, which made this first control installation, was acquired by Republic Flow Meters Co. some 20 years ago. Since then, Republic has carried on the Smoot leadership in the automatic operation of power plants, manufacturing a complete line of instruments and controls for this purpose. For example, a recent Republic development, the Electronic Telemaster, has made possible the control of large boilers where components are so distant that transmission lags in ordinary control systems would prohibit automatic operation.

With this wealth of past experience and an active development program to guide them, Republic engineers are able to give you the latest features in control systems to best meet your present and *future* needs.

REPUBLIC Automatic COMBUSTION CONTROLS

- For all types and sizes of boilers
- For all arrangements of draft
- For all types of fuel firing
- For all load conditions



SHERMAN CREEK STATION

WHERE AUTOMATIC POWER PLANT OPERATION WAS FIRST PROVED PRACTICAL . . . 30 YEARS AGO!

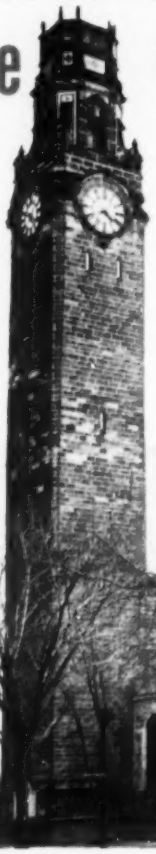
In 1922, Smoot Controls (now incorporated into the Republic line of instruments and controls) were installed on four boilers at New York's Sherman Creek Station in an experiment to test the feasability of controlling combustion automatically. Within five months, the superior performance of boilers with these controls was so conclusively demonstrated that the entire plant, consisting of 44 boilers, was equipped with Smoot Controls. After this test proved it was practical to control boilers with other machines, it was only a short time before automatic boiler controls were installed in scores of power plants all over the country.

2240 Diversey Parkway • Chicago 47, Illinois

For more data circle 509 on Post Card

"How modern **coal** equipment saves us $9,000 a year and solves our smoke problem!"

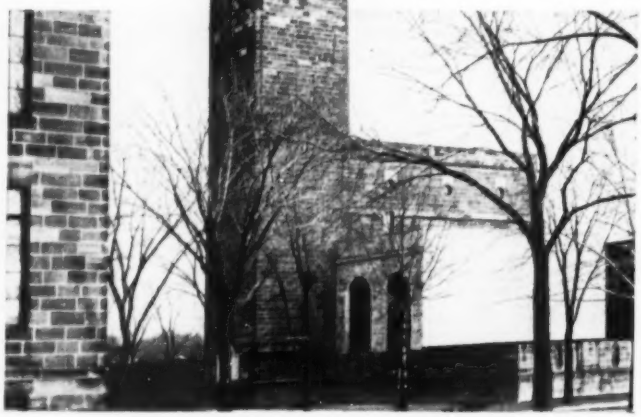
Says Albert E. Unruh,
Chief Engineer
University of Detroit
Detroit, Michigan



This is a smokestack. This beautiful War Memorial Tower actually conceals the smokestack for the U. of Detroit's steam plant. Though it's in the very center of the campus, there's never any smoke problem, thanks to a modern coal-fired power plant.

"Again and again over the last decade, coal burned with modern equipment has proved itself the most flexible, economical fuel for heating our school buildings. We made our first investment in modern coal equipment shortly after the last war. By 'restokering' two existing boilers, we saved $9,000 the first year—actually $2,500 more than we estimated. At the same time, we solved a disturbing smoke and flyash problem and provided enough steam capacity to heat additional new buildings.

"We're completely sold on coal. And when our building expansion program required us to further increase steam production, we again chose a modern coal-fired boiler. Coal has proved its ability to handle increased loads and save us dollars year after year. And modern equipment eliminates smoke nuisance."



Additional case histories, showing how other types of plants have saved money by burning coal with modern equipment, are available upon request.

If you want to cut steam costs, it will pay you to investigate the advantages of modern coal equipment. For example, you may be able to save as much as 20% on fuel alone by replacing outdated equipment with modern stokers and boilers. Or, a small investment in modern controls and other up-to-date, fuel-conserving devices may boost efficiency of your present operation.

You can save on labor, too, by installing modern handling equipment. Modern coal-feeding and ash-removal systems can eliminate practically all hand labor.

Call in a consulting engineer. He can give advice on what equipment best fills your specific needs. And his recommendations may save you dollars year after year.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for *hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D. C.

FOR HIGH EFFICIENCY *FOR LOW COST*

YOU CAN COUNT ON COAL!

For more data circle 510 on Post Card

HELPFUL BULLETINS

VALVES, PIPING, ACCESSORIES

101 Blow-Off Valves — Twenty-pp Catalog 12-D1 features a redesigned line of blow-off valves with flanged or welding ends and bolted bonnets for 300, 400–600, 900–1500 lb sp classes, also welded bonnet models with welding ends for 1500 and 2500 lb sp classes. Includes a discussion on "what you should know about blow-off valves," and gives tips on selection, operation, installation of blow-off valves and boiler code requirements for them. Generously illustrated, this catalog provides tables on specifications, flanged and welding end details. Edward Valves, Inc.

102 Relief Valves — Twenty-pp Publication 5200 is replete with data on company's multiport relief valves for steam, air and gas service. Charts, diagrams, tables and examples of plant operating conditions serve to show how to select a relief valve. Text and illustrations show advantages of these valves over other relief valves, and booklet also shows how the Multiport relief valve can be used as a differential pressure spillover or as a check valve in closed systems. Cochrane Corp.

103 Unions and Valves — Catalog 11, 24 pp, contains full engineering data and specifications on company's Perfect Seal line of hot forged steel pipe unions and swing check valves. Also lists alloy steel and stainless steel unions, and a special section of catalog is devoted to double-start unions which provide faster opening and closing because of double-start threads. Catawissa Valve & Fittings Co.

104 Solenoid Valves — Bulletin RS111, 6 pp, gives construction details, dimensions on four types of Model 73 Solenoid Valves. Outlines applications with schematic sketches to illustrate standard installation. Selection chart is on back of bulletin. A-P Controls Corp.

105 Pipeline Installations — "Pipeline Progress" is a fully illustrated 12-pp brochure showing photographs of many pipeline installations throughout the country for municipalities, utilities, institutions, others. C. N. Flagg Co., Inc.

106 How to Select Bellows — Catalog 140, 16 pp, is a design guide for application and selection of bellows. Covers manufacture, typical uses, specifications. Includes vapor pressure-temperature curve chart for bellows assemblies. Flexonics Corp.

107 Aluminum Jacketing — Economy and reduced maintenance offered by use of company's aluminum jacketing for insulated lines are stressed in illustrated Form J-1. Details fast application, corrosion protection afforded, other advantages. Step-by-step photos show how jacketing is applied. Includes specifications. Childers Mfg. Co.

108 For Hot Underground Pipes — Tips on installation of Gilsulate, a triple-zone insulation for hot underground pipes, are given in this illustrated bulletin. Shows how Gilsulate is poured around pipes, tamped down, and the trenches backfilled. Explains protection afforded, details advantages and includes technical data. American Gilsonite Co.

HEAT EXCHANGERS

109 Heat Exchangers — Bulletin 120 describes operation of company's Aero heat exchangers for cooling or controlling temperatures of industrial liquids. Diagram and photos show equipment in operation. Niagara Blower Co.

110 Heat Exchangers — Form 533012 is a 36-pp catalog covering commercial and industrial heat exchangers. Gives capacities, sizes, dimensions and weights of fuel oil heaters, condensate coolers, water heaters for large steel boilers, tank heating units, converters, others. Taco Heaters, Inc.

ELECTRICAL EQUIPMENT

111 Electrical Modernization — Booklet B-6133, 16 pp, titled "Compete or Collapse", points out need for efficient distribution of electrical power in plants. Describes principal elements of modern system, citing advantages of increased output and safety, lower operating cost, as well as less down-time and maintenance. Westinghouse Electric Corp.

112 On Modernizing an Industry — Electrical modernization of the cement industry is discussed in illustrated Bulletin GEA-5984, 16 pp. Provides step-by-step information on how to modernize electrically without full shutdowns. Includes information on controlled burning, reduction of cement dust losses, economical rock transportation, economy of centralized control, high voltage drives, other subjects. General Electric Co.

113 For Controlled Power — Catalog 254, 32 pp, gives general information on operating principles of company's full line of regulated power equipment, and specific data on each instrument — pictures, general descriptions, electrical and mechanical specifications. Covers electronic a-c voltage regulators, regulated d-c sources, electronic frequency changers, inverters, magnetic-amplifier d-c sources, related equipment. Sorensen & Co., Inc.

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 131-132

114 Automatic Transfer Switches — Publication 502 tells what to look for in selecting an automatic transfer switch. Discusses continuous duty rating, single throw vs double throw, quiet operation, relay protection, need for built-in time delay, operating speed, other important factors. Need for unusually high in-rush currents is explained. Automatic Switch Co.

115 Selenium Rectifiers — Bulletin 177, 24 pp, describes Seletron selenium rectifiers of industrial and other types. Fully illustrated with voltage curves, circuitry, tabular matter and product applications, it includes an expanded tabulation of power rectifiers to 260-v input and 30 amp. Among rectifiers discussed are special ones for magnetic amplifier application. Seletron & Germanium Div., Radio Receptor Co., Inc.

116 Voltage Regulators for Rural Lines — Bulletin B-6054, 20 pp, discusses in non-technical style, rural application of voltage regulators. Gives theory of application on rural lines; describes various types of manufacturer's regulators. Westinghouse Electric Corp.

117 Current-Limiting Reactor — Bulletin B-5918 describes Type MSP self-shielded current-limiting reactors for installation on industrial branch circuits. Shows how these reactors cut costs by eliminating need for complete new protection equipment when "powering up" your main bus capacity, and permits purchase of lower rated protective apparatus for new installations. Discusses use of Hipercrete shields. Westinghouse Electric Corp.

118 Building Wire Handbook — Form BW-1, 34 pp, is a pocket-size catalog covering company's line of building wire. A technical section provides tables and other information most frequently required in selection and use of building wire and cable, all data conforming to 1953 National Electrical Code. Triangle Conduit & Cable Co., Inc.

119 For the Hazardous Spots — An 82-pp reference book, Bulletin 2655 is the 1954 edition of company's catalog on Condulets for hazardous locations. Contains a table listing commercial uses of hazardous substances and their flash points and ignition temperatures; sections of the 1953 National Electrical Code; detailed descriptions of explosion-proof and dust-tight electrical equipment conforming to these Code Articles. Well illustrated, this informative booklet is available to qualified power engineers. Please state your job title when requesting it. Crouse-Hinds Co.

120 Ballast Selection Guide — Bulletin GEC-983B, 6 pp, contains wiring diagrams for 24 fluorescent lamp ballasting circuits, cross-section dimensions, list prices, and electrical specifications for all types of company's ballasts, including those for general fluorescents, outdoor applications. General Electric Co.

MECHANICAL POWER TRANSMISSION

121 Power Transmission Equipment — Form 118, 24 pp, gives descriptive and technical information on variable speed pulleys, wide V-belts, sheaves, motor bases, countershafts, and Select-O-Speed transmissions. Illustrated with photos and dimensional drawings, booklet provides ratings, sizes, application and installation suggestions. Lovejoy Flexible Coupling Co.

122 Silent Chain Drives — A comprehensive study of manufacturer's silent chain drives, 88-pp Book 2425 is well illustrated, compiled for easy reference. An opening section lists pre-engineered stock drives for normal requirements. Another section outlines procedure for selecting completely engineered drives, and includes service factors, rating tables, chain length and center distance computations. A section on drive components lists dimensions, wheel tolerances, materials; one on accessories covers casings and tensioners. Operational and technical data, including installation, maintenance and lubrication procedure are also provided. Link-Belt Co.

123 Belting Handbook — Transmission, conveyor and elevator belting are covered in 28-pp Form 1000-A104. In it, each belting product is pictured in color and tabulated as to specifications, construction and recommended use. A section is devoted to formulas and rules used in estimating horsepower requirements. Boston Woven Hose & Rubber Co.

124 Grommet V-Belts — Bulletin 2170, 8 pp, describes, illustrates company's grommet belts in standard and high capacity construction. Gives procedure for figuring V-belt drives; includes tables on hp ratings, belt selection, sizes, service, other factors. The B. F. Goodrich Co.

125 Miniature Clutches — Catalog B-54 describes miniature one-way roller clutches which permit drive in one direction with free-wheeling action in the opposite direction. Design and installation data and dimensions are given for roller assemblies as well as clutches. Miniclutch Co.

126 Bearing Chart — Designed to enable power engineers to evaluate their bearing functions with respect to 17 service requirements, this chart lists 17 basic performance and application elements to be considered in selecting bearings. It is arranged so that various types may be evaluated. Thomson Industries, Inc.

METALS

127 Alloy Reference Chart — This chart lists chemical analyses, physical properties and recommended applications for 28 grades of cast stainless steel. Indicates ACI, AISI, SAE, ASTN and general "type" designations. Data as to heat treatment and notes on weldability and machinability are included. The Cooper Alloy Foundry Co.

128 Strip and Sheet Alloy — Continuous-cast strip and sheet brass is described as to characteristics and advantages in this bulletin, and some typical drawn-formed-stamped parts are illustrated. Scovill Mfg. Co.

129 Why Porous Chromium — This 16-pp illustrated booklet, presented in question-and-answer form, tells what company's Porus-Krome is and explains how it holds lubricating oil when applied to cylinder bores and other bearing surfaces, thus extending cylinder and ring life. Tells purpose of the pores, why Porus-Krome outwears metals commonly used for cylinder surfaces. The electrolytic process of applying Porus-Krome is discussed, and some typical examples of its use are cited. Van der Horst Corp.

130 Cast Bronze, Copper — Sections of this 24-pp booklet on cast bronze and copper products deal with company's research, process, engineering and production facilities. Also provided is an alloy chart listing composition, analyses, properties and applicable specifications of copper, babbitt, bronze and aluminum alloys. Performance characteristics and specific product uses are listed in a casting guide section. National Bearing Div., The American Brake Shoe Co.

131 Continuous-Cast Bronzes — This 12-pp bulletin describes, illustrates Asarco continuous-cast bronze products including copper alloy rods, valve guides, air brakes, packaging machinery. Tables include typical physical properties of foundry alloys cast by three methods; impact tests revealing high safety factor for heavy-duty parts. Lists specifications, sizes, weights on rods, bars. American Smelting & Refining Co.

. . . Outstanding Among This Month's Catalogs

132 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Industrial applications for other than power boilers are covered and layout drawings of typical preheater arrangements are included. Air Preheater Corp.

133 Water Treatment for Cooling Towers — Bulletin 28X7501A, 6 pp, discusses types of cooling systems together with such problems as corrosion of metal surfaces, inorganic scaling, organic growths, and delignification of the wood in the tower. Data on the proper selection of chemical treatment is included, along with a table showing the type and amount of treatment found effective for prevention of scale or corrosion under various conditions. Allis-Chalmers Mfg. Co.

134 Heavy Duty Fans — Eight-pp Catalog 1380 describes heavy-duty fans with forwardly-curved blading designed for induced draft application in steam plants of public utilities and industrial plants for both process steam and power generation. A graph of the certified horsepower, efficiency and pressure rating of the new blade design is presented, and factors contributing to these ratings are discussed. Construction features are also discussed, and there is a section on optional, inlet damper control. Sturtevant Div., Westinghouse Electric Corp.

135 Voltage Regulator Practice — Because of constantly increasing requirements for close voltage control — coupled with rapid load growth — this company has made available to power engineers 20-pp Booklet B-6053 on modern regulator practice. Fundamental application factors of step and induction voltage regulators are discussed and charts used to show graphically what popular practice is today. Both regulator types are compared as to maintenance characteristics, speed of response. Westinghouse Electric Corp.

INSTRUMENTS AND CONTROLS

137 Recording Controllers — Twenty-pp Bulletin GED-2100 introduces a line of process instruments including potentiometric and a-c bridge recorders and recording controllers designed for continuous measurement and control. Text and photos show how magnetic standard incorporated provides continuous standardization, eliminates components needing frequent servicing, and how the centerless pointer affords increased readability and simplified chart changing. Improved circuitry is illustrated. General Electric Co.

138 Transductor Magnetic Amplifier — Technical Data Bulletin TD 52-601, 8 pp, discusses current and potential transductor magnetic amplifiers for instrumentation, metering and control of d-c currents and voltages requiring isolation. Includes magnetic amplifier terms, applications for transductor Magamps in various systems, operating characteristics. Graphs show rated control current vs. output current of three transductor Magamps. Westinghouse Electric Corp.

139 Heating Control for Oil Burners — Bulletin GEA-6118, 12 pp, fully illustrated, describes, gives step-by-step illustration photos of manufacturer's complete line of oil burner controls. Explains a heating control exchange plan for inoperative controls. General Electric Co.

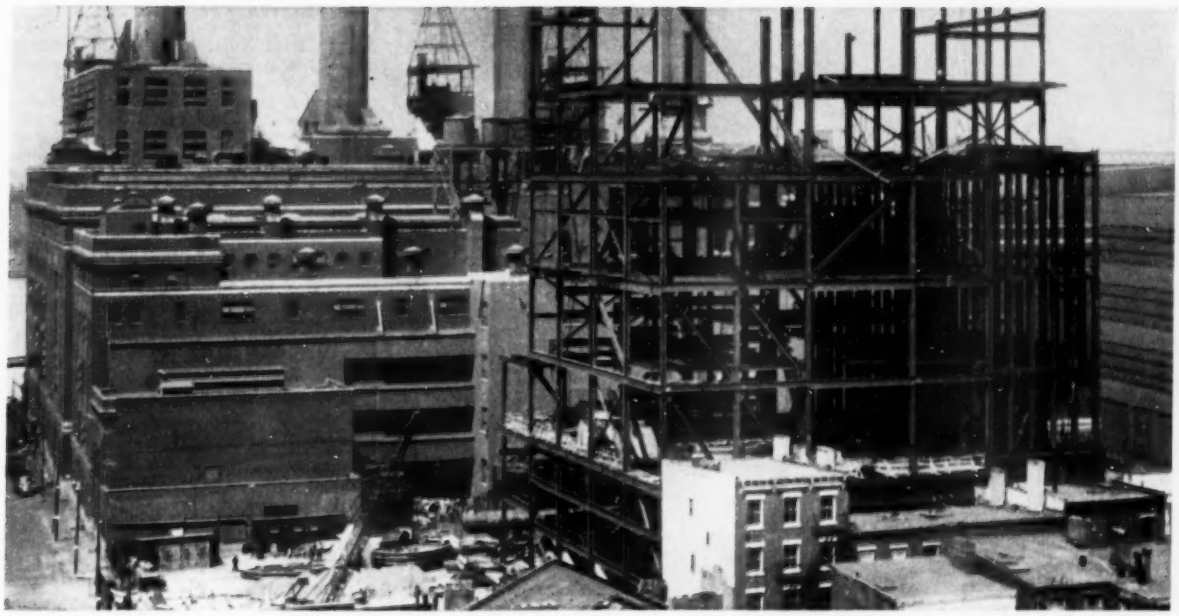
140 For Gas Regulation — A line of gas regulators is described and pictured in 36-pp Catalog 806. Cylinder, manifold and pipeline regulators are presented, along with specifications and operating data. Each regulator has a chart showing types of gages used with it, inlet and outlet connections, maximum flow cfh and maximum working pressure. Catalog is cross indexed; includes flow and pressure charts indicating at what point the regulators can be used to perform a particular job. Air Reduction Sales Co.

141 Miniature Venturi — This 5-pp brochure describes a compact venturi tube designed for measurement of fluids in quantities ordinarily considered too low for use of a normal size venturi or orifice. Pictures components, a completely integrated unit, and tells uses, limitations, discharge capacities. Simplex Valve & Meter Co.

142 Level and Pressure Control — Eight-pp Bulletin 230-K10 describes application of Chronoflo telemetering to level control in reservoirs and elevated and ground storage; to pressure control in pump discharge lines, distribution systems, booster stations, industrial processes, steam and gas lines; and to automatic pump control. Describes and pictures transmitters and receivers, includes diagrams of installation arrangements, and explains operating features. Builders-Providence, Inc.

143 Dial Indicators — Bulletin 254, 6 pp, discusses manufacturer's line of Nilcoid dial indicators with Nilcoid movements and pointer-line dials. Explains advantages of simplified movement (only four moving parts) in eliminating inaccuracy, gear friction and high maintenance costs. Lists specifications of five models. Nilsson Gage Co., Inc.

144 Panel Instruments — Catalog N-1, 8 pp, presents a new method of listing manufacturer's instruments and accessories, their outstanding characteristics, and prices, for both direct and alternating current. Catalog is designed to help user visualize best combination of factors in



CHEMICAL CLEANING REMOVED MILL SCALE FROM BOILER AFTER ERECTION

Dowell Service gave quick, effective cleaning assuring more efficient operation

To provide more extensive service for its customers, a large power company installed a new 1,370,000 lb. per hour boiler. Specifications on this equipment called for Dowell Chemical Cleaning Service to remove any oil, grease, protective coatings, mill scale and rust from the boiler after erection.

To accomplish the purpose, Dowell engineers filled the boiler with solvents especially designed for the job. Using Dowell's equipment, manpower and pump trucks, the entire cleaning job was performed in a few hours.

Dowell has removed as much as three thousand pounds of mill scale and iron oxide from a new boiler.

Unless it is removed, mill scale may retard heat transfer, slough off abrading particles, and act as a base for corrosion. And considerable annoyance may result from black boiler water. The removal of mill scale after equipment is erected can also eliminate much of the extra care required in the handling of previously sand blasted or pickled tubes.

Maintenance engineers in industrial plants throughout the country have learned to rely on Dowell Service for fast, effective and economical cleaning of their operating equipment. How about you?

Experienced Dowell engineers are available to make estimates on your particular problems. Call Dowell today, or write to DOWELL INCOPPORATED, Tulsa 1, Okla., Dept. F-24.

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chemical cleaning service for industry

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a Simplified System . . .

INSTROF

for the support of INSTRUMENT TUBING

Instrof is a standard system of completely designed prefabricated Trough which may be easily laid out and quickly and economically erected at the job site to give light, strong mechanical protection and continuous support for instrument tubing.

Standard fittings include tees, elbows, risers, crosses and other items which allow any change of direction or elevation to be made easily; special pieces can be fabricated for unusual requirements. The entire system can be installed in an extremely short time to conform to almost any plant layout.

Why not call in an Instrof Engineer who will be glad to assist you in planning your installation: In the meantime write for full details—ask for Bulletin 6P.

INSTROF INCORPORATED

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For more data circle 512 on Post Card

design and prices for his own requirements. Burlington Instrument Co.

PROTECTIVE COATINGS

145 High-Heat Paint — Descriptive and technical data on high heat-resisting finishes for temperatures to 1600 F are provided in Technical Bulletin 5311. Physical properties, applications, and economic advantages of special finishes for hot metal surfaces are given, along with directions for use. General Paint Corp.

146 Air-Curing Coating — This bulletin describes uses and application of an air-curing, liquid neoprene protective coating. Points out how it protects against corrosive fumes and splash and is useful for old and new equipment, for general maintenance protection for metal, wood, concrete. Gates Engineering Co.

147 Improved Water Repellent — This 8-pp technical brochure covers the theory, applications and benefits of special silicone resin water-repellent compounds for above-grade exterior masonry. Gives comparative ratings of various water repellents on the market today. Explains how silicones work, and tells how such water repellents reduce maintenance costs and preserve structures. Includes job specifications. Dewey and Almy Chemical Co.

A reference file of up-to-date commercial literature can be a big help to a busy power engineer. You can save time in ordering the bulletins you want by using the postage-free cards on page 131

148 Metal Primer — This folder describes Ospho, a metal primer which is applied right over rust and stops rust action. Tells advantages of Ospho for rusted metal and as a primer for new metal, explaining how it serves to protect the metal. Rusticide Products Co.

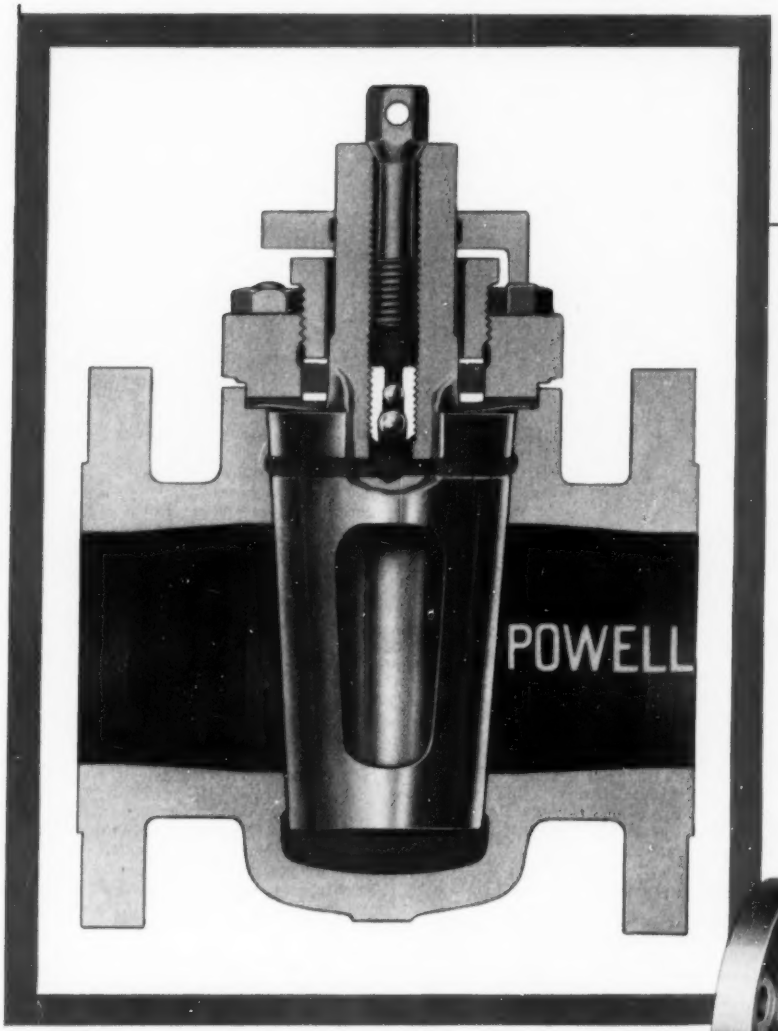
149 Corrosion-Resisting Coating — Bulletin 100, a reference data sheet for the power engineer, defines serviceability, gives cost and estimated life of each material in manufacturer's line of corrosion resisting coatings. Lists practical limitations of each product, classified for use as paints, surfacing materials or linings. Contains chart of coverage, based on mil ft per gal for each product. Carboline Co.

OTHER EQUIPMENT

150 Welding Chart — Here's a colorful and informative hanging chart incorporating nine data charts and 10 photos. The feature chart provides RWMA specifications for spot welding similar and dissimilar metals. Other data charts cover

Powell LUBRICATED PLUG Valves

Now! A great new line of valves that maintain the Powell standards of precision!



Investigate these outstanding new Lubricated Plug Valves that carry the Powell name and measure up to the Powell standards of precision. Features include quick and positive operation – just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

Available in Semi-Steel and Carbon Steel through distributors in principal cities. For descriptive literature—or help on valve problems—write direct to The Wm. Powell Company, Cincinnati 22, O.

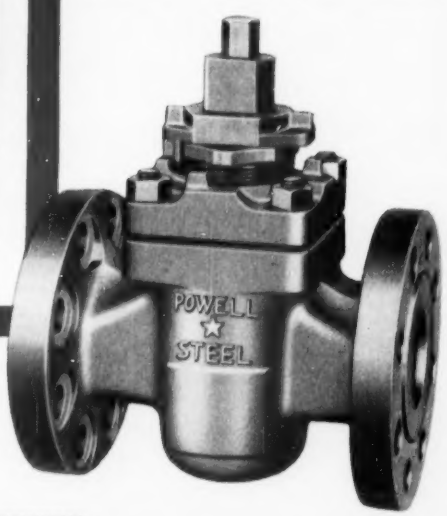


FIG. 1559 — 150-POUND STEEL FLANGED END LUBRICATED PLUG VALVE. *(300-pound Steel, Fig. 3059.)* Available with Screwed or Bolted Glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves *108th year*

For more data circle 513 on Post Card

For easier installation — Lower maintenance

TYPE B DESIGN FEATURES

- Factory fabricated boilers require minimum field work.
- In many cases, sizes up to 25,000 lbs. per hour can be shipped completely assembled.
- Water tubes along furnace side walls reduce maintenance costs.
- Furnace design provides high efficiency with any method of firing.
- Extremely low head room. Maximum capacity for floor area.
- Can be operated at high overloads without disturbing water level.

Write for free catalog on the Type B or on any of the units listed below.

Boilers By Bigelow

Water Tube Boilers — Bent Tube Types • Horizontal Return Tubular Boilers • Scotch Type Boilers • Two-Pass Boilers • Electric Steam Generators

This Type B — Boiler By Bigelow being installed was shipped completely assembled. It has a capacity of 20,000 lbs. steam per hr. continuous, 25,000 lbs. steam per hr. peak loads. The boiler is 10'7" wide, 21'9" long, 15'10" high and has 3,287 square feet of heating surface.

THE BIGELOW COMPANY ; NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Philadelphia • Syracuse • Detroit • Atlanta • Milwaukee • New Orleans • Petersburg, Va. • Washington, D.C. • San Francisco • Los Angeles • Seattle • Indianapolis • Kansas City, Mo. • Tulsa • Salisbury, Md.

BI-7A

For more data circle 514 on Post Card

properties of Ampco-Weld, high conductivity alloys, projection welding, conversions on commonly welded metals, etc. Photos show holders, tips, seam welder shafts. Ampco Metal, Inc.

151 Report on Entrainment Elimination — Illustrated Case Study 1001 shows how the installation of a stainless steel wire mesh section in an asphalt vacuum still stopped entrainment and increased capacity. Tells how the wire mesh installation was made, and includes full data on operating conditions before and after installation. Otto H. York.

152 Unit Heaters — Bulletin 543-B illustrates commercial and industrial, gas-fired warm air unit heaters with output capacities of 88,000 to 160,000 Btu per hour. Describes a type for suspended mounting and one that can be built into duct type or air conditioning systems. Also includes tables listing heating and air delivery capacities, outlet temperatures, air pressure drops, sizes. Dravo Corp.

153 Quick-Opening Doors — Bulletin 2435, 8 pp, outlines advantages of newly developed quick opening doors for pressure vessels. Explains how these doors can be opened and closed in seconds, and are adaptable to both vertical and horizontal units. Process Equipment Dept., Blaw-Knox Co.

154 For Faster Tube Rolling — Eight-pp Bulletin P-318 describes an electro-pneumatic tube rolling control designed to combine portability, powerful air operation and precision electric control. Pictures the unit in action, discusses its advantages and explains how it is built and how it works. Crane Packing Co.

155 Rupture Discs — Catalog 77-30, 6 pp, fully illustrated, gives construction features of a rupture disc for low pressure and highly corrosive applications, sizes 2 through 10 in., and rupture pressures from 5 to 100 psig. Discusses operation, pressure ranges, manufacturing tolerance, choice of materials. Black, Sivalls & Bryson, Inc.

156 How to Get the Right Washer — Sixteen pp of helpful information and pictures on the manufacture and availability of metal and fiber washers, both standard and special, are provided in this booklet. Contains data on general washer characteristics, tolerances, and facilities for meeting individual requirements. H. K. Metalcraft Mfg. Co.

157 Diatomite Filters — How filtration of water, other liquids for industrial use can be obtained efficiently and economically by diatomite filters is described in Bulletin WC-115. Text, photos and schematic diagrams show typical arrangements of filters and explain how the liquid is passed through a form of silica — diatomaceous earth. Stresses space saving afforded by these filters over others of same capacity. Graver Water Conditioning Co.

158 Automatic Boilers for Oil, Gas — Bulletin 1230, 8 pp, discusses manufacturer's new line of simplified Powermaster packaged automatic boilers, including oil, gas burning, and combination units in nine sizes from 15 hp through 100 hp, thus covering steam requirements to about 3450 lb/hr, also hot water designs. Gives details of design and construction, sample specifications. Orr & Sembower, Inc.

159 Air Compressors — Compact, centrifugal air compressors of 800 to 1200

R/M's BIG 7 Packing Types meet 95% of all packing needs

Rotary pumps like this one, which handles 10 gallons of highly viscous materials (10,000 SSU) per minute at 1200 rpm, give top performance with R/M No. 376, a packing included in Type 4 of R/M's Big 7 Packing Types.

Let R/M packings protect your machines

Increased machinery protection is one of the very real advantages you get when you standardize on R/M's Big 7 Packing Types. The reason is that they're engineered to give custom-built performance in all but the very rarest packing applications. You can also count on this basic line of just seven field-tested packings to lower your maintenance costs, cut your downtime, reduce your inventories, and simplify your ordering. It will enable you to practice preventive rather than corrective maintenance. The entire requirements of your plant can probably be met with just three or four of R/M's Big 7 Packing Types. For details, see your R/M distributor.

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BIG 7 PACKINGS

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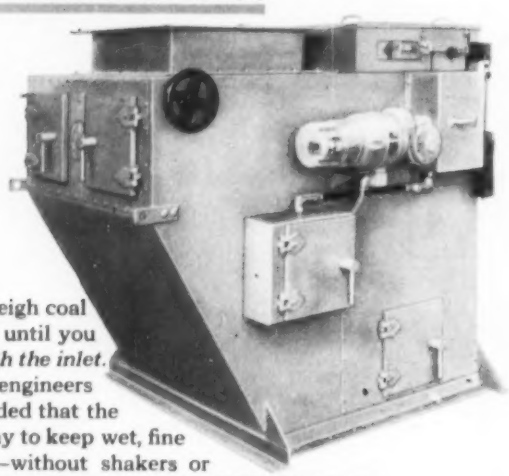
For more data circle 515 on Post Card

the hourglass shape...

...it may have been fine for Fannie,

but it has no business here!



You can't weigh coal in *any* scale until you *get it through the inlet.* Richardson engineers have concluded that the only sure way to keep wet, fine coal flowing—without shakers or vibrators—is to make that inlet BIG ENOUGH. So they opened up the "wasp waist" to a full 24″ x 24″, and around it they built the best coal scale it was possible to develop from fifty years' experience, the Richardson H-39.

If you're interested in maximum coal scale *efficiency* at wholly reasonable cost, specify a 24″ x 24″ minimum, and *know* that your coal will flow. That is the starting point from which the H-39 is soundly engineered in every feature, every detail. It's built as a coal scale *should* be, from the inside out, with a full 4 square feet of inlet. Get all the details, mechanical specifications, and drawings in Bulletin 0352.

3081

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Richardson
MATERIALS HANDLING BY WEIGHT SINCE 1902

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Detroit • Houston • Memphis • Minneapolis
New York • Omaha • Philadelphia • Pittsburgh • San Francisco • Wichita • Montreal
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cfm, 90 to 120 psig, for broad industrial use, are described in this illustrated folder. Discusses continuous service afforded by these compressors, drives available, shaft seals provided, special materials of construction that can be furnished, and maintenance requirements. Sawyer Bailey Corp.

It's easy to get these free catalogs—just circle item numbers of those wanted on the two post cards provided on pages 131-132.

160 Preheater Tubes — How Vitralloy preheater tubes help in maintaining of high boiler efficiencies is told in Catalog 3154. Explains and illustrates how these tubes are used, and tells why their higher cost is justified. Includes price list. Barrows Porcelain Enamel Co.

161 Cleaning Equipment Chemically — This bulletin, titled "Chemical Cleaning for Industrial Equipment," tells how company's service works to remove scale from boilers, superheaters, condensers. Gives recommended applications and cleaning results for piping systems, utility lines, water wells. Dowell, Inc.

162 Data on O-Rings — This 12-pp engineering brochure on O-rings gives detailed information on compounds, groove dimensions and sizes. Contains diagrams of typical applications and is intended to facilitate choice of O-ring seals for many applications. Goshen Rubber Co., Inc.

163 Weldless Rolled Rings — Eight ways to improve product design through use of weldless rolled rings are explained in this folder. Describes and pictures rings in sizes to 240 in., weights to 40,000 lb. Advantages are presented along with typical applications including ring gears, heat exchangers and vessels. Ladish Co.

164 Dust, Fume Control — Dorfan dust and fume control systems for the collection of fumes from dryers of all types, electric steel furnaces, other installations, are detailed in this bulletin. Lists other company products including dust and fume filters, arresters, rotary valves. Mechanical Industries, Inc.

165 Need a Barge? — All types of welded steel barges for river and harbor use are described in 28-pp Bulletin 227. A section is devoted to hopper barges used by the power industry to transport large tonnages of coal, other cargo. Dravo Corp.

166 Lifting Jack Manual — Catalog 204, 40 pp, is a well-illustrated manual which explains how to choose the right jack for the job, and gives information on proper care and maintenance. Lists types of manufacturer's ratchet, screw and hydraulic jacks, from 3 to 100-ton capacities; gives specifications. Duff-Norton Mfg. Co.

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 JUNE 1954 Number 3

Process Bottleneck Cleared

Emergency solution of a water quality problem smashed a production bottleneck in a new midwest plant. Temporary measures adopted provided immediate relief, allowing time for design and future installation of permanent deionization equipment without the costly slowdown that would otherwise have been unavoidable.

A critical process operation called for absolutely spotless pipe sections. Although the rigid specifications for cleaning these pipes were carried out conscientiously by the plant personnel, spotting still occurred. Tan and white stains appeared on the internal surfaces when the clean sections were air-dried after a final hot water rinse. Rejections became such a problem that Hall service engineer, R. G. Hobek heard of the difficulty. Sensing that the water supply might be the critical factor, he called on Hall's specialist on metal cleaning, C. T. Roland.

Investigation of the water source and the setup for drying the pipe sections showed that as little as 5 to 10 ppm of dissolved solids in the rinse would show up in stains as the rinse water evaporated from the pipe surface. Available raw waters showed total solids in a range of 350-450 ppm.

As an immediate relief measure, Mr. Roland recommended that the plant install a temporary tank so that steam condensate from various traps in the building could be stored and used as makeup for the hot water rinse tank. In addition, he recommended that the pipe be hoisted from the tanks in such a way that the water would drain in a thin sheet from the surface. The pipe would then dry rapidly and any dissolved solids would deposit only in a small area around the lower ends.

Since condensate might not be permanently available, deionization of the water supply was recommended.

On a follow-up visit, Mr. Hobek found that the temporary changes in procedure had doubled the output of pipe, and that during the two days he observed the operation not one piece of pipe had to be recleaned.

Emergency measures such as those instituted at this particular plant are not always feasible. One way to avoid an unexpected roadblock is to seek advice *before* setting up an industrial operation using water.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Reprints Available

Reprints of "Practical Performance of Water Conditioning Gadgets" by B. Q. Welder and E. P. Partridge of Hall Laboratories are now available. This paper, presented in October, 1953, at the 14th Annual Water Conference of the Engineers' Society of Western Pennsylvania and now reprinted from the May, 1954, issue of Industrial and Engineering Chemistry, reports field observations of the performance of various devices claimed to be effective in treating water by non-chemical means. Write for your copy to Hall Laboratories, Inc., P. O. Box 1346, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Engineer Tracks Down Culprit

When Hall engineer R. D. Hugus recently reported to headquarters on trouble-shooting at a Great Lakes manufacturing plant, his running reports on the job sounded like a popular "whodunit."

First Report

"In response to a call, I visited plant at 10:00 p.m. to see what the trouble was. Two boilers were in service and water level was swinging. Hooked up cooling coil and checked steam samples. Found boilers carrying over severely."

Second Report

"Set up conductivity equipment on two boilers. I could not do a thing with the boilers regardless of whether water level was high or low. Carryover was terrific. Some conductivity values on condensed steam were 1200 micromhos—boiler water was 1800 micromhos.

"Cut off all condensate returns from E section of plant. Blew boilers every fifteen minutes with continuous blowdown valves wide open. Ran over week end this way. Conductivity came down to 4-5 micromhos and has been holding there.

"Checked samples from various points in E section. Found severe contamination at a process point where steam is used for washing parts. Material used in washing contains wetting agent. Condensate from washer will be sent to sewer."

Final Report

"No further difficulty with water level since contamination corrected."

Case Closed

"Water level in boiler now holding steady. Traps in return system also functioning much better. Drastic fluctuations no longer evident. This has been accomplished by bringing back only good quality condensate."

For more data circle 517 on Post Card

Service . . . where and when you want it

PROMPT, experienced service is one of the most important plus values you get when you buy Honeywell instruments. An unequalled organization of trained specialists is always at your call at more than 110 offices in the United States and Canada. Offices are located in practically every large industrial city of the country . . . close to every major production center.

Trained Personnel

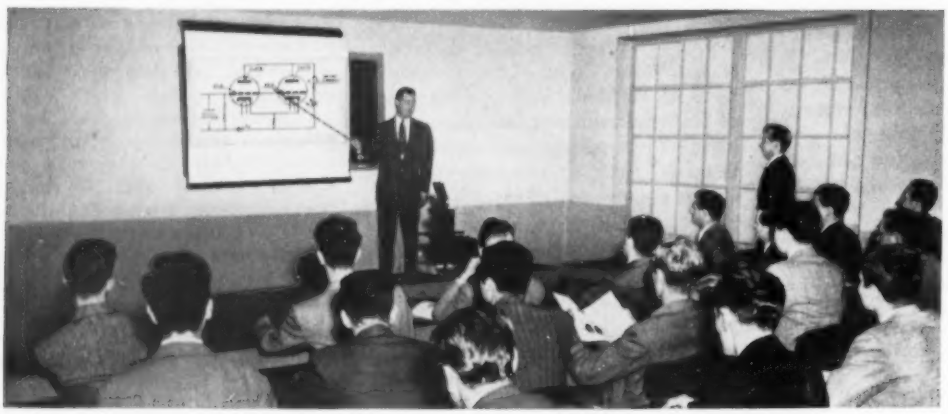
Honeywell service men are schooled not only in the theory of measurement and control, but also in the practical art of keeping good instruments in the best condition. Hand picked men begin this instrument education in an intensive training program in Honeywell factories. After graduation, they serve an apprenticeship in the field offices . . . while they learn still more about instrument maintenance from first-hand contact with plant problems. By the time a Honeywell man arrives at your plant on a call, he's a finished product worthy of the responsibility he bears, and capable of doing the kind of service job that you need . . . and that your Honeywell instruments deserve.

When trouble strikes, a wire or telephone call will bring a service man to your plant . . . often within a few hours. This assurance of prompt action means a lot to your production schedules. You'll never be left out on a limb because of delays in instrument maintenance.

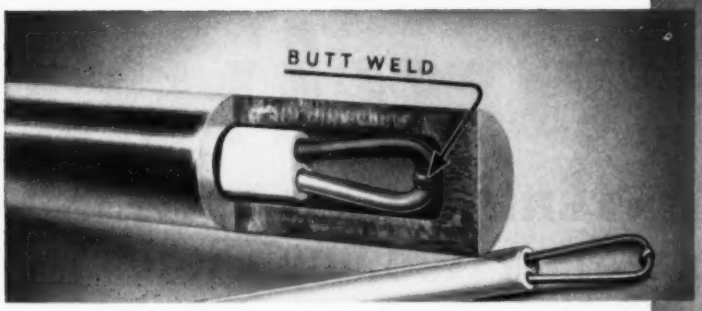
Periodic Service Plan

But why wait for emergencies? Preventive medicine works on instruments, too. And the prescription is simple . . . a Periodic Service Contract, which brings a Honeywell service man to your plant at regular intervals to inspect, clean and adjust any Honeywell instruments you have. The plan is economical . . . can save you many hours of lost production time. Your nearest Honeywell office will be glad to give you full details.

A faster, stronger *for steam*



TRAINED TO SERVE: *In Honeywell's service school, students get a thorough grounding in instrument theory and practice. After graduation, they become part of the most extensive organization of its kind in the world . . . ready to serve you competently and promptly, whenever and wherever you need them.*



FOR getting high-speed, precise measurements of steam temperatures, the Brown butt-welded thermocouple is the ideal partner for *ElectroniK* instruments. This thermocouple's unique characteristics come from an entirely new kind of design, in which the two couple wires are electrically welded together in a butt joint.

The thermocouple is *faster*—because the mass of the junction is much smaller than the usual twisted joint. It's *stronger*—withstands vibration and shock better. And it's *more accurate*—because the loop formed at the joint prevents heat conduction from the junction back to the insulators.

A wide line of thermocouple wells is supplied for various steam plant applications . . . including a series especially designed for high pressure steam lines. All Brown thermocouple wells are precision-machined to highly uniform wall thickness, to guarantee dependability at high temperatures and pressures. They are available in a broad choice of standard sizes and designs, supplemented by special types made to individual specifications.

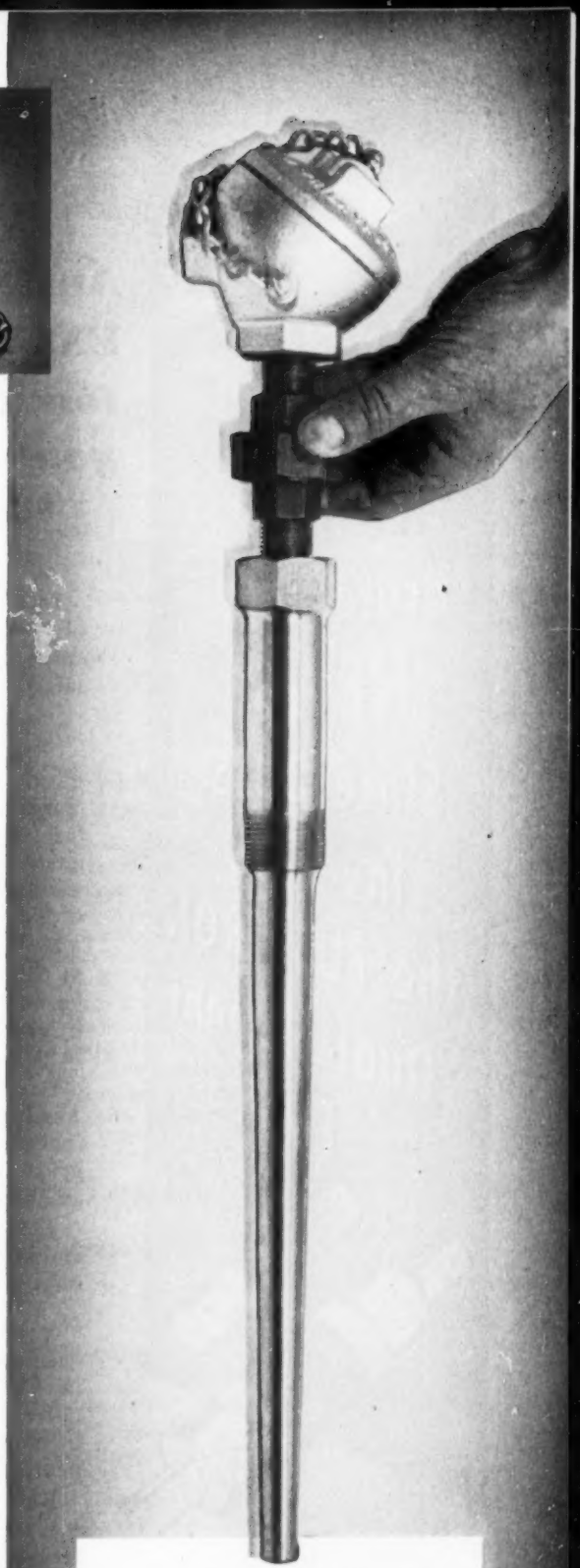
thermocouple *plant temperatures*

For specifying and purchasing all instrument supplies and accessories, you'll find new convenience and economy in the Honeywell Supplies Man—HSM—Plan. Your local HSM will be glad to explain the plan in detail, and to show you how planned buying can save you time and trouble. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

REFERENCE DATA: Write for Pyrometer Supplies Buyers' Guide No. 100-4 . . . and for Specification Sheet No. 200-2 on Thermocouple Wells.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



STEAM THERMOCOUPLE *has tapered stainless steel well, precision-drilled to highly uniform wall thickness. Inset shows butt-welded thermocouple junction. The small mass gives fast response . . . curved wires prevent heat conduction away to the insulators.*

For more data circle 518 on Post Card

Now!...

An INTERRUPTING RATING in EXCESS of 100,000 AMPERES *for every set of fuse clips in your plant* . . . simply by installing FUSETRON *dual-element* FUSES

The Biggest Electrical Protection NEWS Since BUSS invented the FUSETRON Dual-Element FUSE

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

In 1947 tests made by the Electrical Testing Laboratories of New York, showed that on a circuit set to deliver 50,000 amperes, FUSETRON fuses in all tests cleared the circuit safely.

50,000 amp. Interrupting Capacity in 1947
becomes
100,000 amp. Interrupting Capacity Today

After years of intensive development work on FUSETRON fuses new tests were conducted under conditions that simulated the most severe field conditions and these tests were witnessed and verified by the Electrical Testing Laboratories of New York.

On circuits set to deliver in excess of 100,000 amperes, 30 to 600 ampere, 250 and 600 volt FUSETRON dual-element Fuses on each and every test cleared the circuit without belching flame or venting hot gases and with comparatively little noise.

Oscillograms of these tests interpreted by the Electrical Testing Laboratories, showed that the total available amperes including the direct current component, reached values as great as 165,000 peak amperes on 240 volt tests and as high as 212,000 peak amperes on the 535 volt tests.

This indicates that an interrupting rating of 100,000 amperes for FUSETRON dual-element fuses is a conservative one.

No interference with time-lag

In the development work to increase interrupting capacity in FUSETRON fuses it was kept in mind that the time-current characteristic must be maintained. Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses.

Remarkable results have been achieved. Interrupting capacity has been greatly increased while the time-current characteristic of FUSETRON fuses has in no way been disturbed.

Play Safe – install Fusetron Fuses throughout the entire electrical system!

Think!...

ALL THIS ADDED SAFETY *without changing a panelboard or switch... plus* 10 Point Protection of FUSETRON *dual-element* FUSES!

Maximum Safety

With FUSETRON Fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every FUSETRON fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to *pay extra* for "safe" equipment. Wherever a FUSETRON fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

When FUSETRON fuses have once been installed properly you can forget about them. They need no periodic inspections to see if they will operate safely.

Dust, fumes, corrosion or age cannot prevent a FUSETRON fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

With FUSETRON fuses — you get safety — without one cent spent for inspection or maintenance costs.

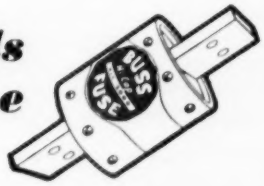
No Recalibration Costs

When a FUSETRON fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS— a fuse that is as safe and dependable as the one that blew.

PLUS 10 POINT Protection with FUSETRON dual-element FUSES

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

for SAFE PROTECTION on loads above 600 and up to 5000 Ampere install BUSS Hi-Cap FUSES



Tests have shown that BUSS Hi-Cap fuses have unlimited interrupting capacity on circuits of 600 volts or less.

They are designed to give protection against dangerous overloads as well as high fault currents — yet their speed of operation on heavy shorts limits currents to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with FUSETRON dual-element fuses they will not open ahead of the fuses nearest to the fault. Thus trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

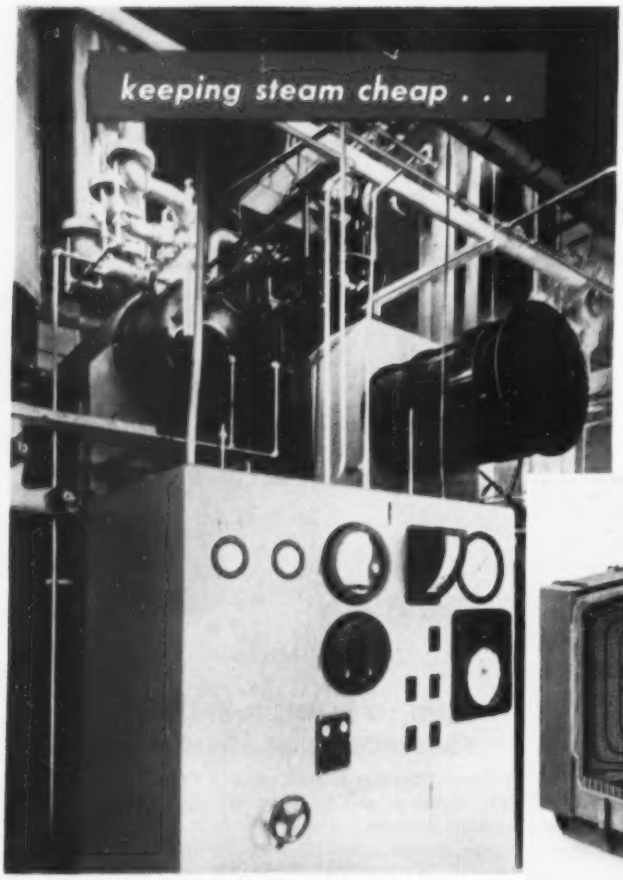
ACTION THAT SAVES YOU MONEY

By passing the word along that all purchase and stock records should call for FUSETRON fuses on loads up to 600 amps—and BUSS Hi-Cap fuses on loads above that — you get action that begets money saving.

For blowing time charts or more information on FUSETRON Fuses and BUSS Hi-Cap Fuses write for Bulletins FIS and HCS.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. Division McGraw Electric Company

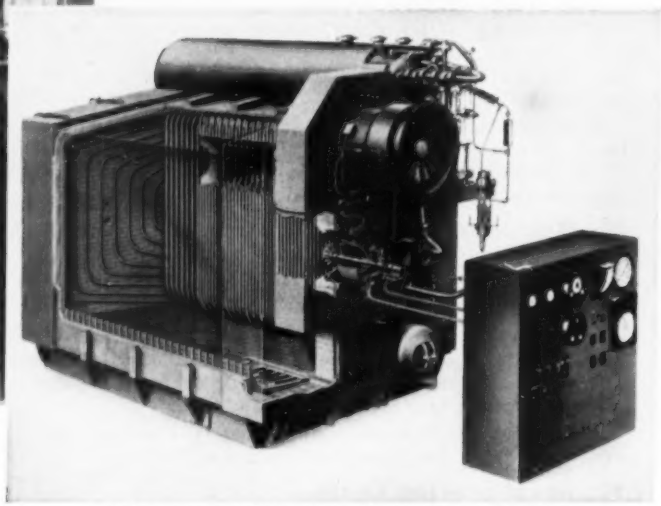
For more data circle 519 on Post Card



One of the three B&W FM Boilers at the Buffalo Plant.

B&W Type FM Boilers Provide Economical and Efficient Steam Generation at

AMERICAN - Standard



Typical arrangement showing sectional view of the FM Boiler and the control panel.

Since replacing five old units more than a year ago, three modern B&W Integral-Furnace Boilers, Type FM, have set and sustained high standards for economy and operating efficiency at the Stamping Plant of the American Radiator & Standard Sanitary Corporation in Buffalo.

Selected on the basis of previous experience with B&W Boilers—both FM and larger types—which are now producing steam at various other plants of the company, this multiple-unit FM installation has pleased both management and plant personnel. Overall boiler operating efficiency is 85%. Each of these versatile, self-contained, B&W units has a steam capacity of 27,500 lb per hr and is equipped with fully automatic controls. Designed for pressures to 250 psi, all three FM boilers are providing high pressure processing steam as well as steam for heating.

The choice of B&W FM boilers to supply plant steam requirements is an established trend that is putting more and more of these shop-assembled units into service for the broadest variety of industries, utilities, and other users, both here and abroad. Because it offers compact, "package boiler" benefits along with cost-saving big boiler advantages, B&W's FM Boiler is already in service or on order for a total steam capacity of more than 7,000,000 lb per hr. You can get this unique B&W "workhorse" in a range of standard sizes, for loads from 2900 to 28,000 lb of steam per hr at pressures to 235 psi. It is also obtainable for operation at higher pressures.

Features of B&W Integral-Furnace Boiler Type FM

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Suitable for Outdoor Service
- Safe, Automatic Operation
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space

Write for Bulletin G-76 which gives complete details of the many cost-saving features of this popular, small boiler. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

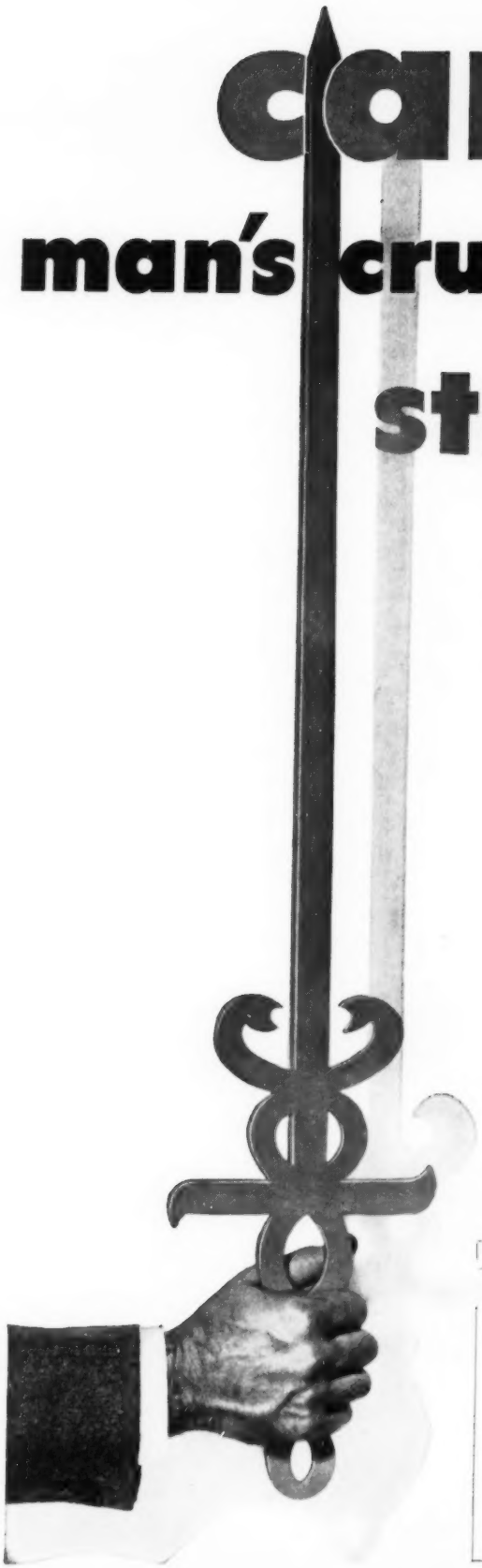
G-634

BABCOCK & WILCOX BOILER DIVISION

For more data circle 520 on Post Card

cancer

man's cruelest enemy strike back



"CANCER" is an unpleasant word. It's easier not to think about it—to turn the page, to pass on.

MOST FOLKS who see this ad, will do just that . . .

YOU ARE DIFFERENT. The fact that you're still reading this proves it.

PERHAPS you have a special reason of your own for being interested in the fight *against* cancer. Cancer may have taken away someone whom you loved. It's not unlikely, for cancer strikes one out of five of us. The young. The old. The strong no less than the weak.

LAST YEAR, Americans contributed more than ever before to the American Cancer Society. But still not enough. Not nearly enough for the struggle that *must* be waged if this implacable enemy is to be conquered for good—if we are to make cancer, like so many once-dreaded diseases, only an unpleasant *memory* in man's long and victorious struggle against his ancient enemies.

THIS YEAR—please—give more generously than ever. For your help is *needed* more than ever. Won't you please clip the coupon *now*—?

American Cancer Society

GENTLEMEN:

☐ Please send me free information on cancer.

☐ Enclosed is my contribution of $..... to the cancer crusade.

NAME.....

ADDRESS.....

CITY..... STATE.....

Simply address the envelope:
CANCER c/o Postmaster, Name of Your Town

Depend on LADISH

To Meet All Your Fittings Needs With an Unsurpassed Range of Sizes and Materials

Ⓛ
TO MARK PROGRESS

1 BUTT WELDING FITTINGS

2 A.S.A. FORGED FLANGES

3 FORGED SCREWED OR SOCKET WELDING FITTINGS

4 T.E.M.A. HUB & RING FLANGES

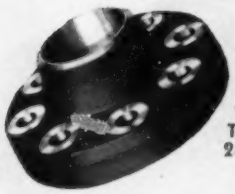
5 LONG WELDING NECKS

6 LARGE DIAMETER FLANGES AND RINGS

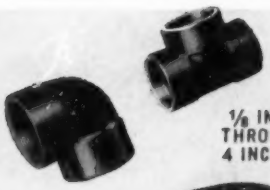
Available in...

Complete Service . . .

1/8 INCH THROUGH 42 INCHES



1/2 INCH THROUGH 24 INCHES



1/8 INCH THROUGH 4 INCHES

6 INCHES THROUGH 46 INCHES

1/2 INCH THROUGH 24 INCHES

UP THROUGH 20 FEET O.D.

CARBON, STAINLESS AND ALLOY STEELS, ALUMINUM, NICKEL AND OTHER FERROUS AND NON-FERROUS METALS

To Meet Your Entire Fittings Needs with a Line Complete In All 6 Major Types

For dependable service that results from an ideal combination of broad line and ample stock . . . specify and buy LADISH . . . the Controlled Quality line that offers a complete range of sizes, types, weights, pressure ratings and materials needed for virtually any piping installation. Your local Ladish distributor's ample stock is backed by complete factory inventories to keep your piping jobs on schedule. So, for *complete service* in fittings . . . specify and buy LADISH.

For your new 304-page Ladish Fittings Catalog, No. 55 contact your Authorized Ladish Distributor, your local Ladish District Office, or write to Ladish Co., Dept. POE, Cudahy, Wis.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED TO ONE STANDARD OF UNSURPASSED QUALITY

LADISH CO.

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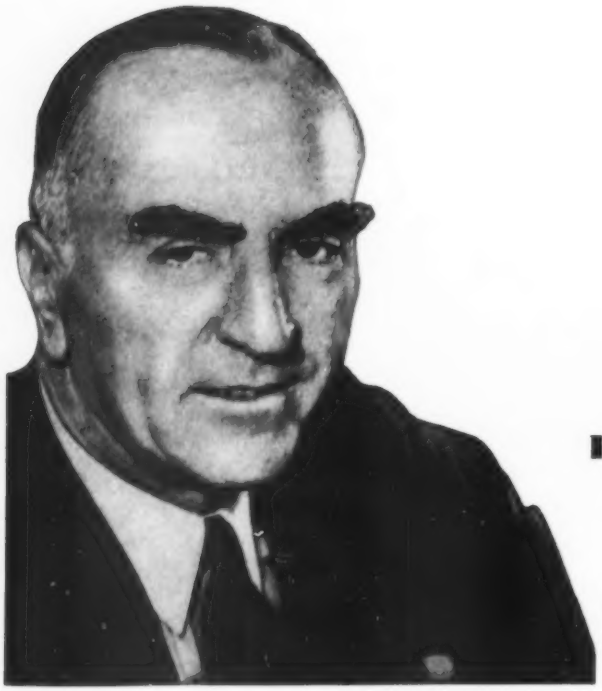

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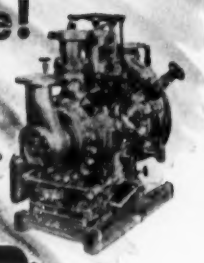
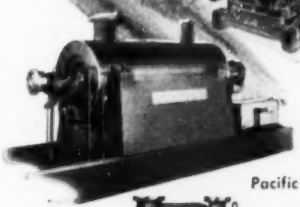
It takes a lot of water to fill a 7-foot pipe!

To bring the hot water to all the Pacific Boiler Feed Pumps placed in operation in 1953 would require a pipe 7 feet in diameter...

Today practically all of the large power generating companies throughout the United States have one or more Pacific Pumps in feed water service. Pacific Boiler Feed Pumps now operating include small vertical type units handling 47,700 pounds per hour at 710 psig discharge pressure—to very large horizontal type units handling 800,000 pounds per hour at 2430 psig discharge pressure. Bulletins 106, 109 and 118 giving details available on request.



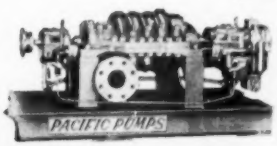
Pacific Steam Turbopump



Pacific Type IBF

Pacific Type ABF

Specify **Pacific**
CENTRIFUGAL BOILER FEED PUMPS



Pacific Type JBF

Pacific Pumps inc. ONE OF THE DRESSER INDUSTRIES
HUNTINGTON PARK, CALIFORNIA
Export office: Chanin Building, 122 East 42nd Street, New York
Offices in all principal cities

BF 19

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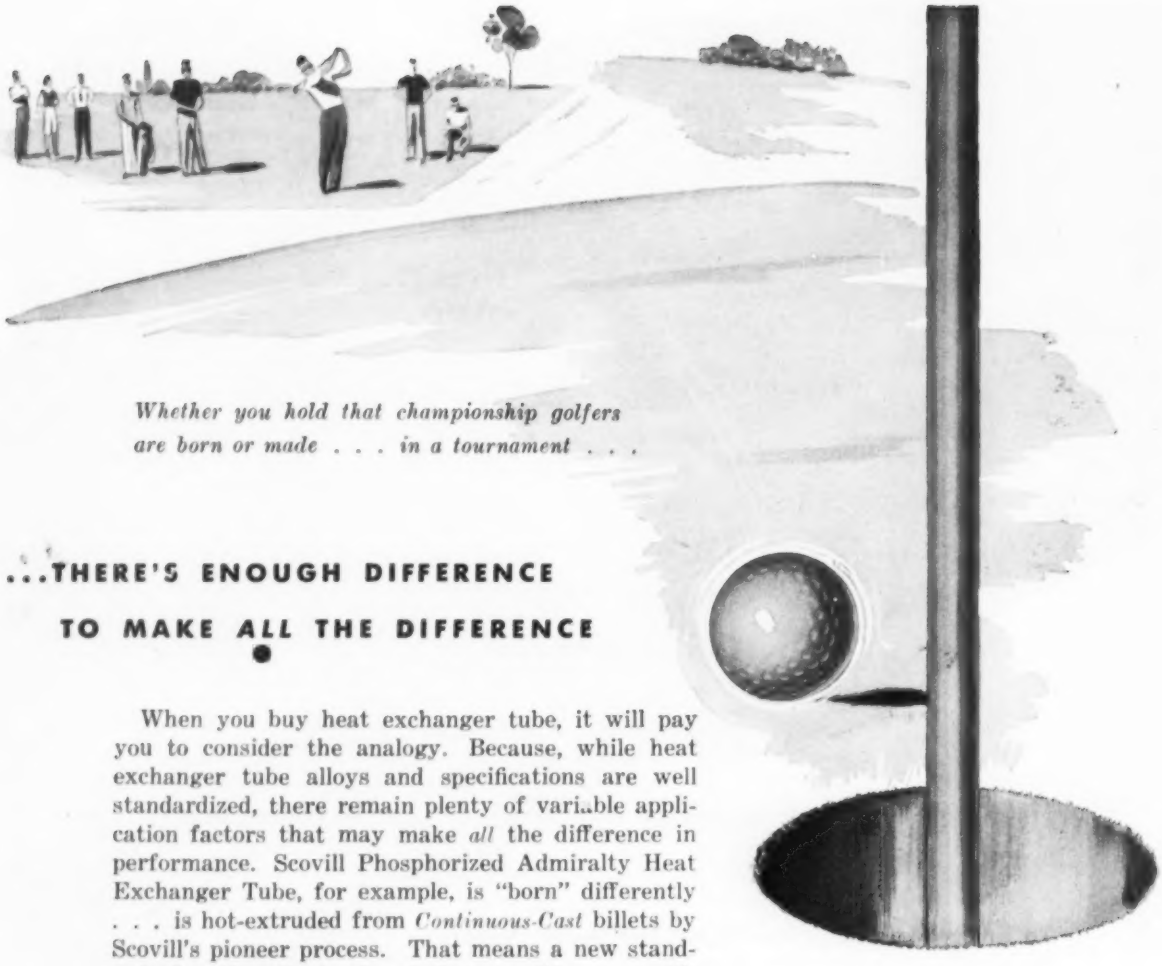

Whether you hold that championship golfers are born or made . . . in a tournament . . .

. . . THERE'S ENOUGH DIFFERENCE TO MAKE ALL THE DIFFERENCE

When you buy heat exchanger tube, it will pay you to consider the analogy. Because, while heat exchanger tube alloys and specifications are well standardized, there remain plenty of variable application factors that may make *all* the difference in performance. Scovill Phosphorized Admiralty Heat Exchanger Tube, for example, is "born" differently . . . is hot-extruded from *Continuous-Cast* billets by Scovill's pioneer process. That means a new standard of uniformity in chemical composition . . . with optimum, uniformly distributed, controlled phosphorus content. It means sound metal — smooth, dense, free from pits or porosity. Such important differences in this and other Scovill Tube Alloys can make all the difference in efficient, economical service under tough operating conditions.

You will also find equally important differences in Scovill's unrivaled Heat Exchanger Tube Technical Services. Ask us to prove it on your next new installation or re-tubing job. The Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Connecticut. Phone Waterbury 4-1171.

SCOVILL
HEAT EXCHANGER TUBE

Phosphorized Admiralty ★ Admiralty ★ Arsenical Admiralty ★ Muntz Metal ★ Naval Brass ★ Red Brass, 85% ★ Deoxidized Copper Arsenical Copper ★ Copper Nickel, 10% & 20% ★ Cupro Nickel, 30% ★ Aluminum Brass ★ Aluminum Bronze, 5% ★ Duplex Tube

6SC54

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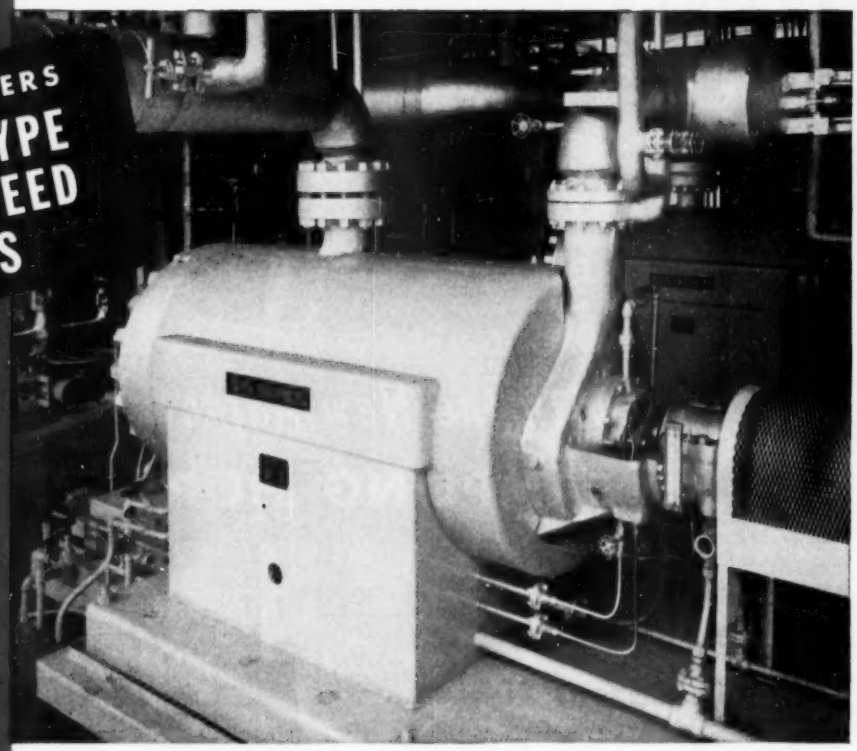
ALLIS-CHALMERS

BARREL-TYPE BOILER FEED PUMPS



Preferred by
LOUISIANA POWER & LIGHT COMPANY
because

PERFORMANCE IS PROVED *in service*

PERFORMANCE RECORDS in power plants all over the country show *low maintenance, high efficiency*... that's one reason Allis-Chalmers boiler feed pumps were chosen for the Nine Mile Point Station of Louisiana Power & Light Company.

PROVED DESIGN FEATURES

Behind the A-C boiler feed pump stand many proved design features. For example: First stage has twin, single suction impellers to give low NPSH requirements for highest efficiency under fluctuating loads. Impellers mounted back to back balance axial forces without the need for a balancing drum. Expansion joint and seals are brought to the outside of the pump . . . they may be inspected often and worked on easily, if required.

COMPLETE UNIT FROM THE SOURCE

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — all of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis., and ask for Bulletin 08B7899.

A-4328

ALLIS-CHALMERS

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NOW! the American SAMPLE CRUSHER

with the New Adjustable SAMPLING HOPPER

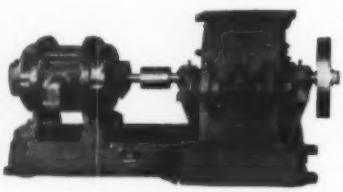
gives you a 5%-10%-15% or 20% Sample of a Sample

Model 9x9 American Sample Crusher with adjustable sampling hopper.

. . . in One Operation!

THE NEW American Adjustable Sampling Hopper gives you a truly representative sample . . . as much or as little as you need, in any amount from 0 to 20% *by simply setting a dial* . . . and does it in *one* operation — so quickly and efficiently that there is no loss of moisture content in the sample.

When teamed up with one of the famous American Sample Crushers (as the Model 9x9 illustrated above), your crushing operations are FAST, because you can crush as much as a ½ ton per hour . . . EFFICIENT, because you have a once-through operation . . . and LOW COST, because there's practically no wear-out to an American Sample Crusher.



Model 15x9 American Sample Crusher, for capacities up to 2,000 lbs. per hour. For larger capacities, we recommend the American "13" Series (capacities up to 6 tons per hour).

WRITE for complete literature on American Coal Sample Crushers

American PULVERIZER COMPANY

Coal Crushers up to 800 TPH
Sample Crushers up to 6 TPH

Originators and Manufacturers of Ring Crushers and Pulverizers

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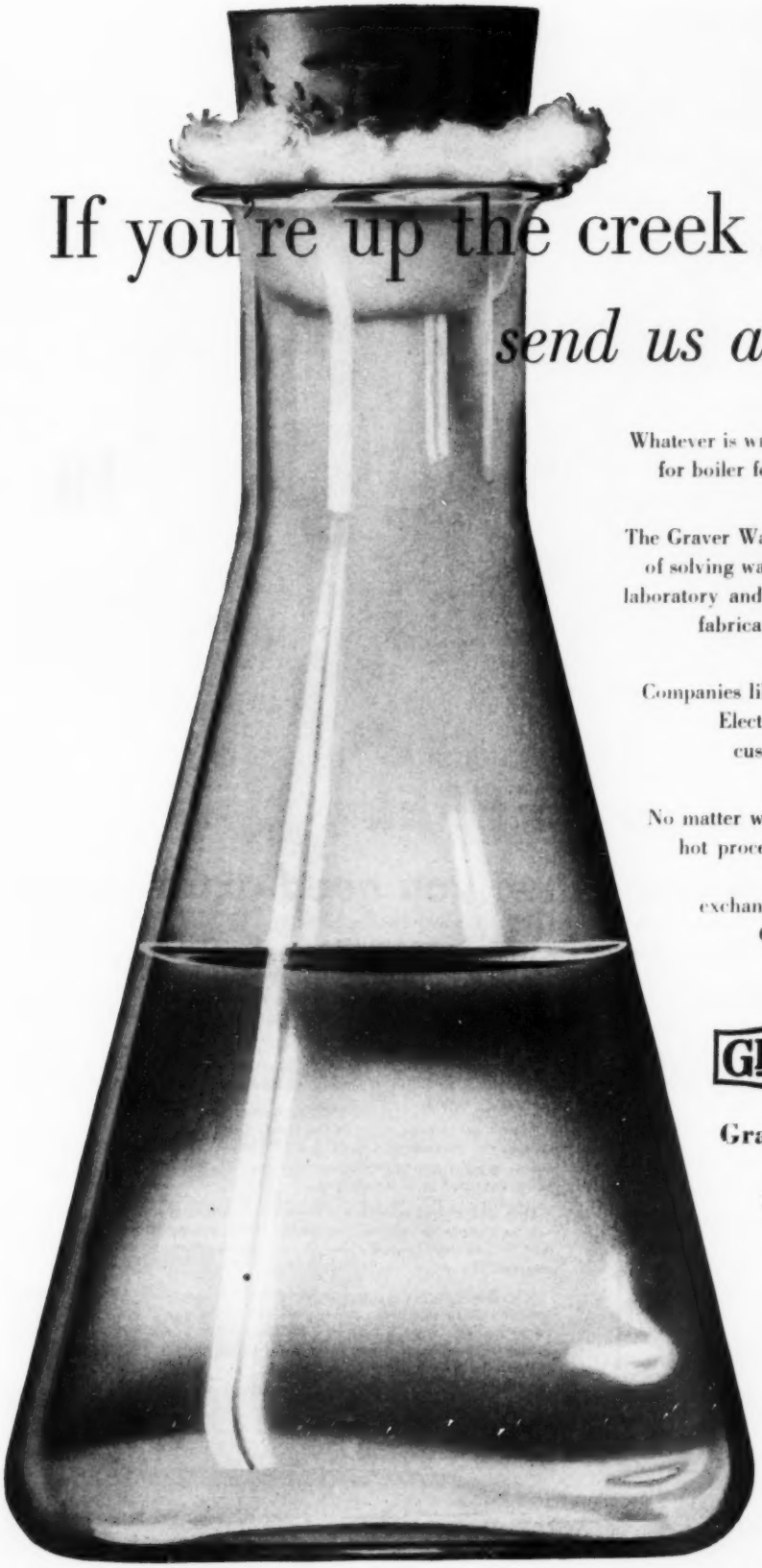

If you're up the creek...

send us a sample

Whatever is wrong with your natural water supply . . . for boiler feed, for process, for almost any purpose . . . there's an answer to the problem.

The Graver Water Conditioning Co. is in the business of solving water treating problems . . . with research, laboratory and pilot plant testing, equipment design, fabrication, erection services, whatever it takes to give you the water you need.

Companies like Esso, Dow, U. S. Steel, Philadelphia Electric, and Procter & Gamble are Graver customers. They wouldn't be if we didn't know our business.

No matter what process or product is required . . . hot process-hot zeolite softeners, Reactivators®, filters, deaerators, demineralizers, ion exchangers, clarifiers, or what have you . . . Graver equipment, backed by 40 years of experience, can help. We will do the whole job or any part of it, from problem through planning to erection.

GRAVER

Graver Water Conditioning Co.

A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th St., New York 11, N.Y.

● *Go to Graver for Water Conditioning*

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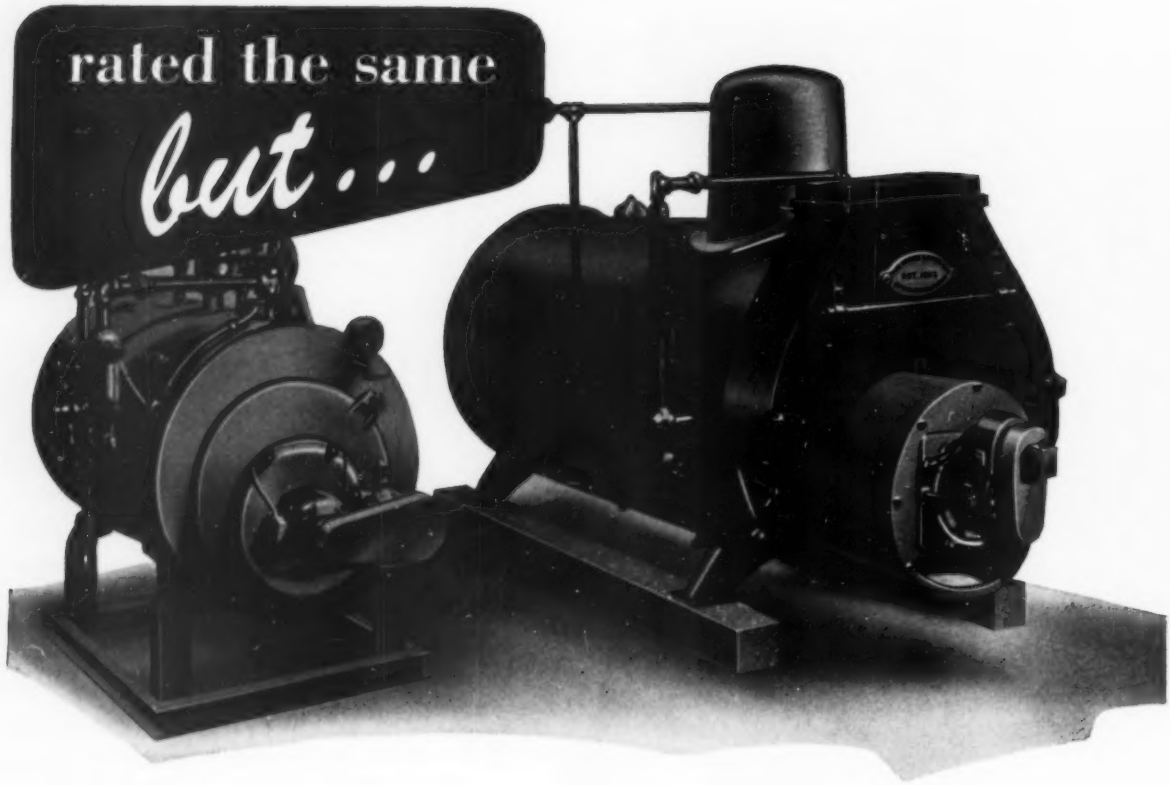


only the bigger, stronger LEFFEL

can deliver when you need extra steam

Look at these figures

	LEFFEL BOILER	A "PACKAGE-TYPE" BOILER
Rating	20 HP	20 HP
Length	9'	6' ±
Height	6'8"	4'6" ±
Heating Surface	181 sq. ft.	54 sq. ft. ±
Shipping Weight	6500 lbs.	2500 lbs. ±
ACTUAL MAXIMUM CAPACITY	40 HP 1380# per hr.	20 HP 690# per hr. ±

It will pay you — in the long run — to compare carefully and buy wisely.

The Leffel boiler is rated at 20 H.P.; so is the little "package-type" steam boiler. All similarity ends with that claimed rating.

The package boiler may deliver 20 H.P. — but no more. The Leffel boiler can be operated day after day at *50 percent above its rating;* in an emergency it can deliver up to 40 H.P. with safety.

Claims can't help you get steam from a boiler which is prone to break down under the strain of continuous operation — which just can't deliver beyond its rating.

There's no corner-cutting in the construction of a Leffel boiler. It's built to take it. Performance proves that Leffel's extra-rugged construction means greater dependability and longer life, plus the ability to carry a 100% overload in an emergency.

One look should tell you that the bigger, obviously stronger Leffel boiler will be a more reliable source for the steam you need. And you will find that despite their greater strength and greater capacity, Leffel boilers are competitively priced.

If you're looking for a completely dependable source for low-cost steam, trouble-free service and simple operation, you'll want to know more about Leffel boilers. They are built in a complete range of sizes from the smallest to the largest Scotch types, for oil, gas or coal firing. Bulletin 236 has all the details; send for your copy today.

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPT. A, SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT STEAM GENERATION FOR 92 YEARS

For more data circle 527 on Post Card

"OPERATION BAGASSE"

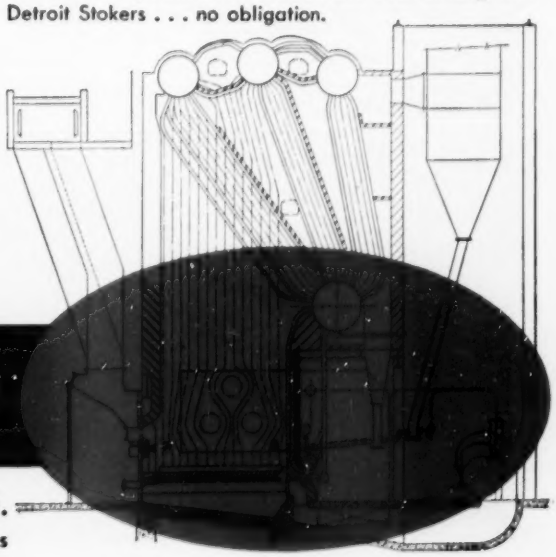
DETROIT ROTOSTOKERS AN OUTSTANDING SUCCESS BURNING BAGASSE AT Hawaiian Commercial and Sugar Co., Ltd.

These Bagasse Burning Detroit RotoStokers are outstandingly successful in burning Bagasse in the plant of the Hawaiian Commercial and Sugar Co., Ltd., Punnene, Maui, Hawaii.

Equipped with special feeders, they handle the Bagasse continuously and distribute it uniformly in each furnace. No coal or other supplementary fuel is needed. The stokers have steam power operated dumping grates. The boilers are Babcock and Wilcox Stirling type with water cooled furnaces. Design capacity of 50,000 pounds of steam per hour at 160 psi saturated per unit when burning Bagasse only has been exceeded.

Our Spreader Stokers are built to burn many types of refuse fuel, including Bagasse, wet and dry wood bark, hogged wood, spent coffee grounds, paper mill refuse, corn cobs, etc., separately or in combination with all grades of Bituminous Coals or Lignite.

Write for special booklet on Refuse Fuel Burning with Detroit Stokers . . . no obligation.



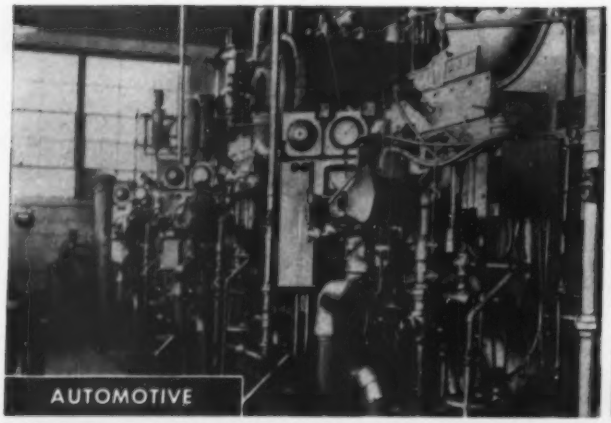
DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

Works at Monroe, Mich. • District Offices in Principal Cities

For more data circle 528 on Post Card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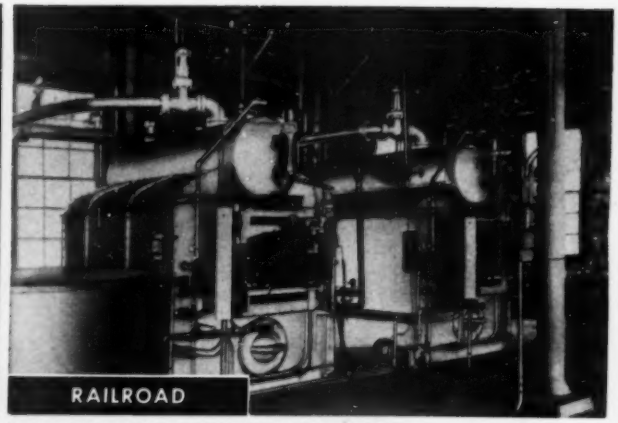
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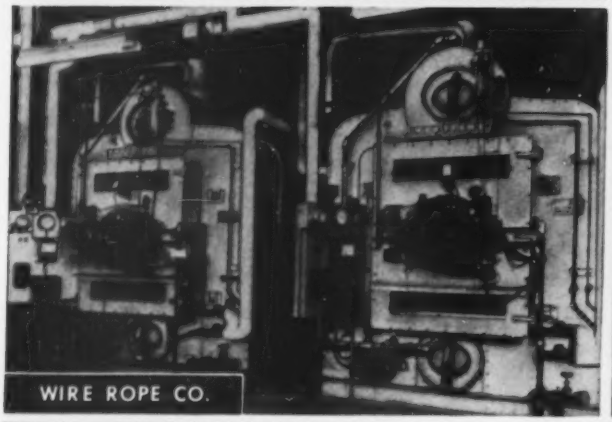
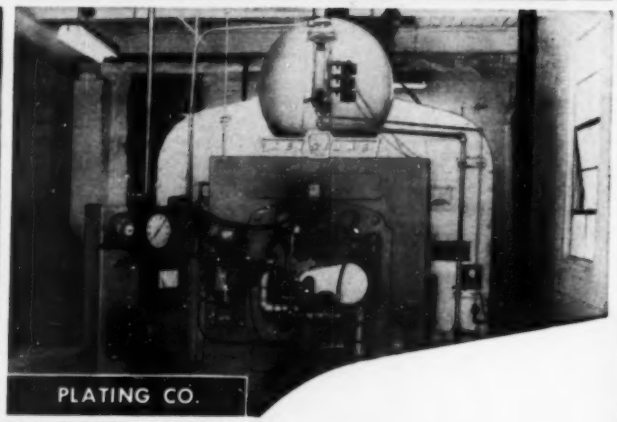
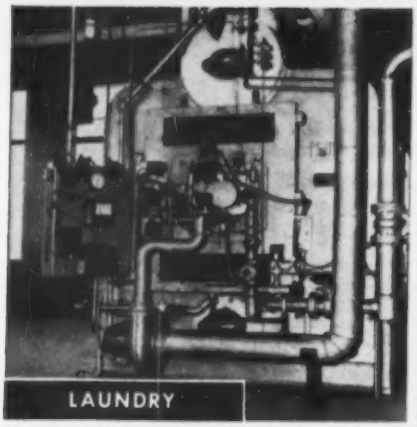
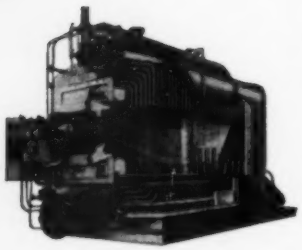
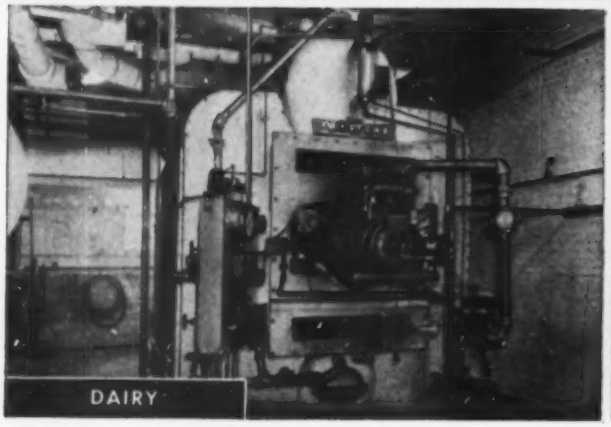

WIRE ROPE CO.

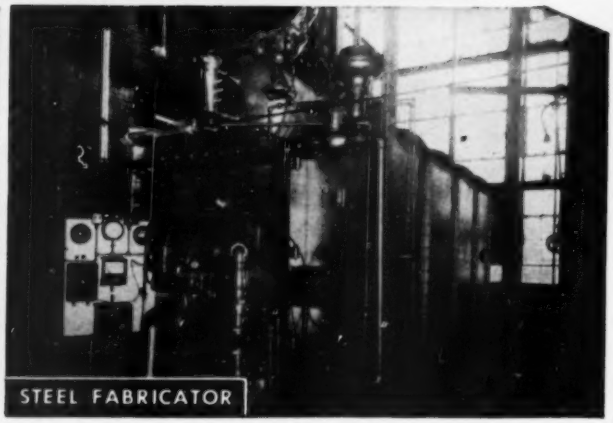

PLATING CO.

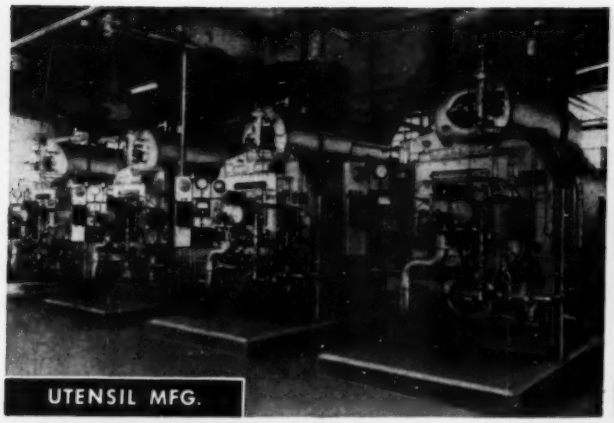

LAUNDRY

You can depend on Erie City for sound engineering ~

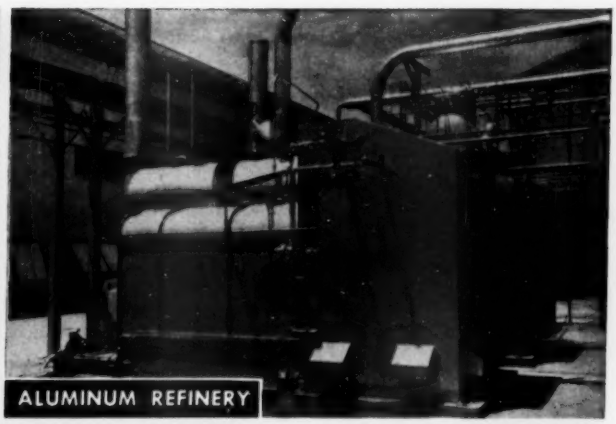



DAIRY


STEEL FABRICATOR



UTENSIL MFG.



ALUMINUM REFINERY

Acceptance

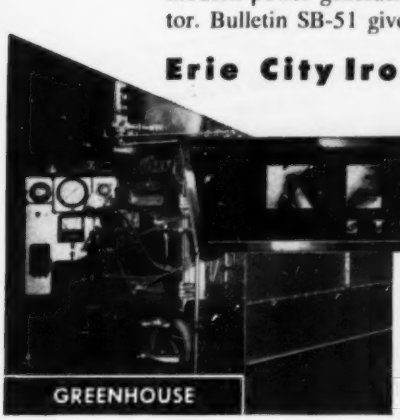
THAT IS EARNED

Erie City Iron Works has hundreds of successful Keystone package water tube boiler installations in all types of industry. True acceptance of any product is the result of successful installations, operating under all types of conditions. Acceptance of the Keystone Steam Generator did not just happen . . . it was earned.

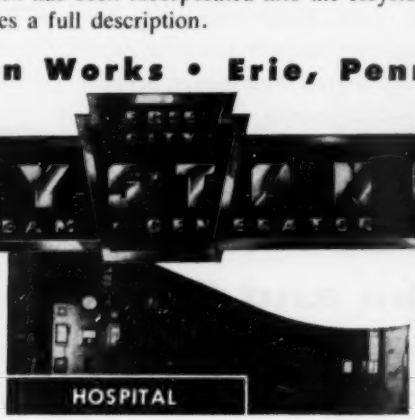
We are proud of our successful installations, operating both indoors and outdoors, with operating pressures ranging from 15 to 600 psi, and producing from 2,500 to 35,000 pounds of steam per hour.

The Keystone is a soundly engineered 2-drum water tube boiler which comes complete with burner, controls and fans all mounted, piped and wired. Add to this the fact that your Keystone is FACTORY FIRE TESTED and you can be assured of a successful and trouble free installation. Every desirable advantage of modern power generation has been incorporated into the Keystone Steam Generator. Bulletin SB-51 gives a full description.

Erie City Iron Works • Erie, Pennsylvania



GREENHOUSE



HOSPITAL

SUGAR MILL

For more data circle 529 on Post Card

"All day I watch the coal go by!"

"Train after train. Day and night. Year after year. You wonder where it all comes from and how long it can last."

• • • • • • • •

You're right, Pop, it's a lot of coal—close to half a billion tons a year. Yet, in the more than a century this country has been mining coal, we have used up only a little over one percent of our known supply. 98.8% of the coal that nature put under our soil is still there for future generations.

That is something to think about when you are considering a new heating plant for home or industry. Other fuels will be getting scarce. Every year the wells go deeper. More and more of our fuel oil comes from foreign fields. Growing scarcity can mean uncertain supply and higher relative prices.

Coal you can be sure of. There will be a plentiful supply for many centuries to come. And the price advantage that makes coal a most economical fuel today is likely to grow with every passing year.

COAL
FUEL OF THE FUTURE

Chesapeake and Ohio Railway

Bring your fuel problems to C&O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

Write to:
Coal Traffic Department
Chesapeake and Ohio Railway
2116 Terminal Tower
Cleveland 1, Ohio

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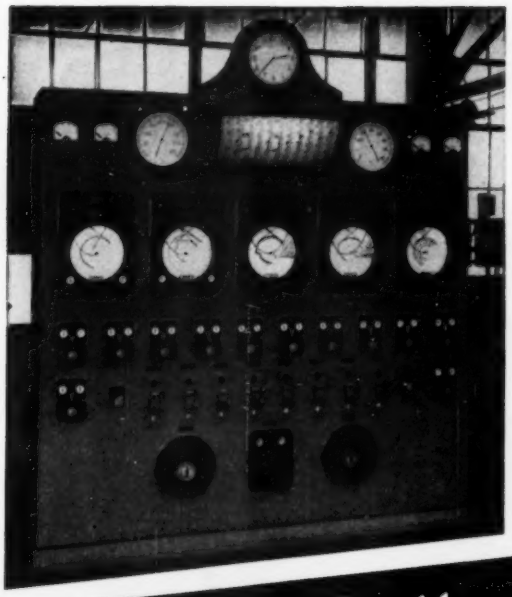

This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

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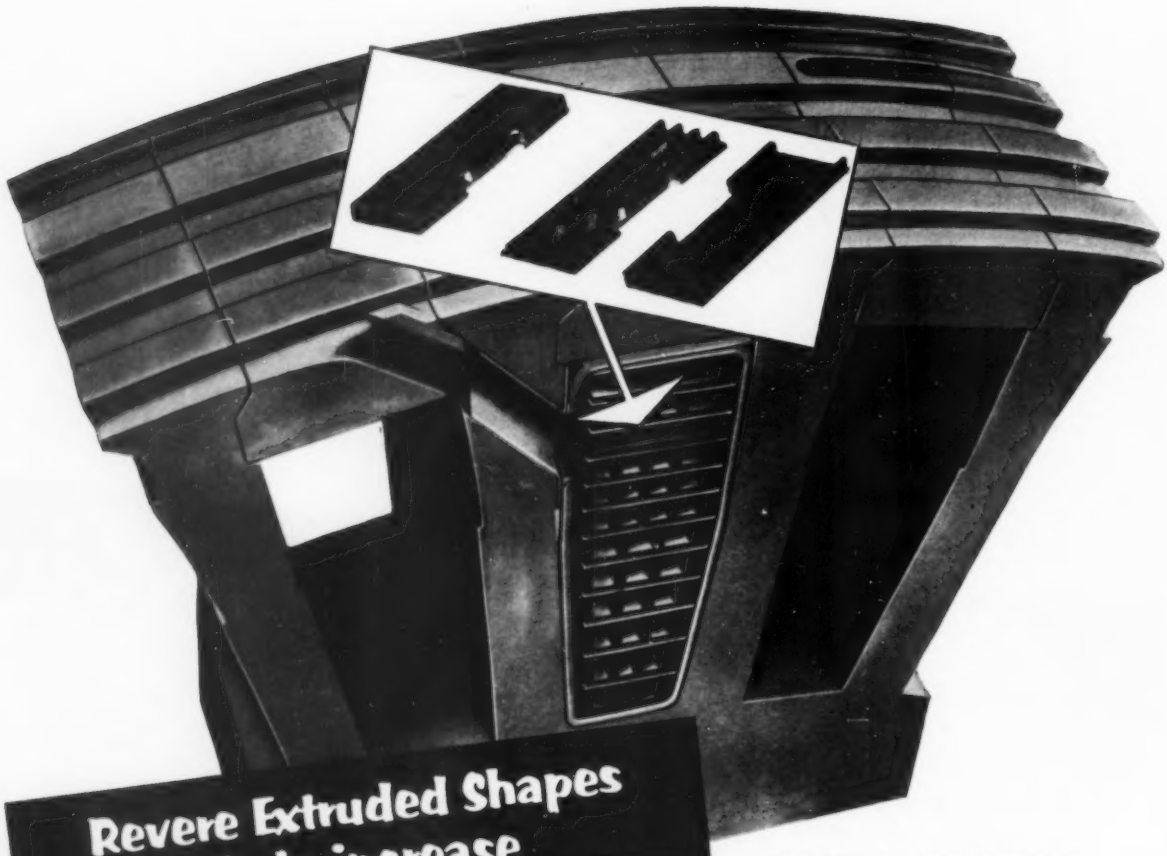


Revere Extruded Shapes help increase ELECTRIC GENERATOR OUTPUT

(perhaps you, too, could use our shapes to your advantage)

Model section of G.E. direct-cooled rotor for turbine-generator. Note intake scoop at left front, hollow copper conductors of extruded shapes, in center, exhaust outlet at right rear.

Insert shows typical extruded shapes after milling by G.E. to provide circulation of hydrogen throughout the field coils.

Winding temperatures are an important limitation upon the output of electric utility generators. They must be kept within safe limits to avoid damaging the insulation. Hence all generators have some method of cooling. Conventionally, the heat passes from the copper conductors in the rotor, through the insulation (which presents a formidable barrier to heat transfer) to the steel parts of the rotor body, and air or hydrogen is pumped through and around the rotor. It was realized long ago that more effective cooling could be obtained if some way could be found to remove the heat directly from the rotor coils.

Some years ago generator engineers of the General Electric Company, Schenectady, New York, proposed making each turn of the rotor coils of two copper extruded shapes; one a channel, the other comb-like. Fitted together, they would make hollow passages for the hydrogen, which would be taken in through scoops on the surface of the rotor, and exhausted through outlets some distance away, also on the rotor surface. In that way, the rotor could be quite uniformly and more effectively cooled throughout its length, and output greatly increased in relation to the physical dimensions of the generator.

An important problem was found in the extruded shapes. Design requirements had to be adjusted to the opportunities and practicalities of the extrusion process. Today these copper shapes, 20 feet long, drawn and finished to strict specifications as to dimensions and straightness, are making it possible to remove four times as much heat as conventional systems, and to double the generator output with no increase in size... For full information on extruded shapes, see the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

For more data circle 532 on Post Card

Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

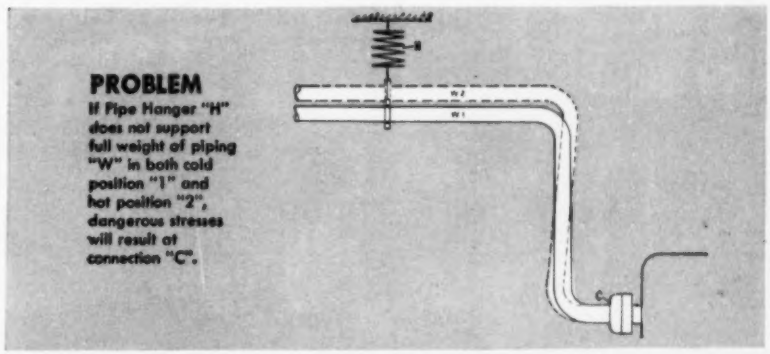
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

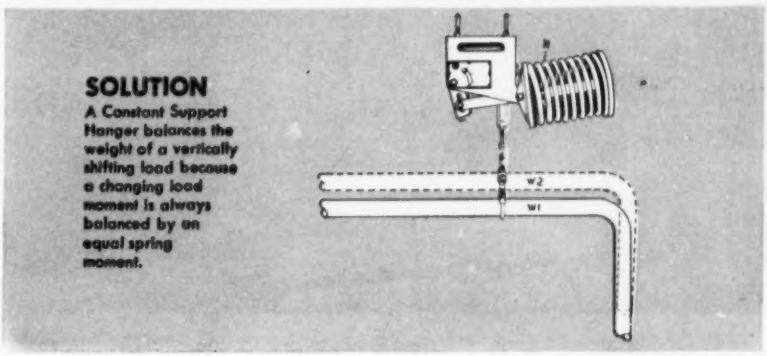
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

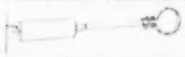

PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".
W2
W1
C


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.
W2
W1

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

GRINNELL COMPANY, INC.

280 West Exchange St., Providence, Rhode Island

Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

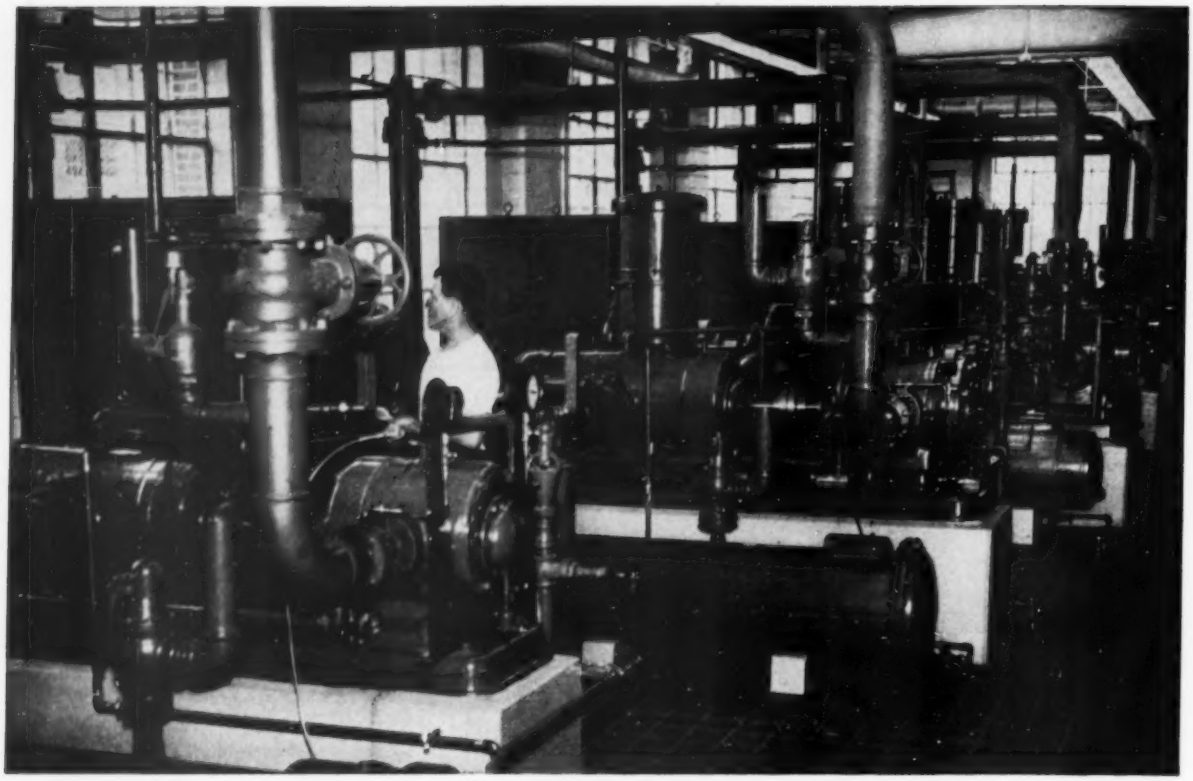
Name.....

Company.....

Address.....

City.....State.....

For more data circle 533 on Post Card



mold Air Power to your needs as this founder does

Six Fuller Rotary Compressors work day after day at Textile Machine Works, Reading, Pa.

Compressed air, produced in one central location, is used for many foundry operations at Textile Machine Works, Reading, Pa., makers of full-fashioned hosiery machinery.

Many molding operations are mechanized at Textile Machine Works, using compressed air. Sand supply-hopper gates are opened by compressed air, jolt-squeeze machines operate with compressed air, pattern plates are removed from molds with air—sand blasting, core making, compacting flask sand, handling push-pallet plates—a whole group of foundry operations simplified by the use of compressed air supplied by Fuller Rotary Compressors.

Starting with a two-stage Fuller Rotary Compressor in 1943, this company has added more compressors as production was increased, until recently the sixth unit was added, supplying a total of 6800 cfm at 125 psi. Each addition was a Fuller Rotary Compressor, a sure indication of reliability and economy of operation.

In your own foundry or process operations, compressed air can save time and money—especially when it is supplied by reliably efficient Fuller Rotary Compressors. Don't overlook the advantages of *air power*—put it to your work—write now for complete information.

Fuller

FULLER COMPANY
Catasauqua, Pa.

Pioneers of high-efficiency vane-type rotary compressors

Branch Offices: Chicago • San Francisco • Los Angeles • Seattle • Birmingham

C-238
2048

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You get

LOW INSTALLATION COST

When you get
B&W Welded Boiler Tubes

Uniform strength, wall thickness and diameter, together with high ductility and ease of rolling-in are assured when you specify B&W Welded Boiler Tubes. As these factors make tubing easier to install, you will have low installation cost.

For three-quarters of a century, B&W has been directly concerned with developing and applying boiler tubes for all pressures up to those approaching 3000 psi. The application of this extensive knowledge and experience results naturally in the production of finer welded boiler tubes.

If you want ease of fabrication and long service life for the tubing in your boiler—choose B&W Welded Boiler Tubes.

LOOK FOR THIS
—wherever fine boilers are operating efficiently over extended periods.

To meet the specifications of time, say B&W before you say WELDED BOILER TUBES —for service-proved dependability.

B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

TA-4034(CWP)

For more data circle 535 on Post Card

EQUIPMENT NEWS

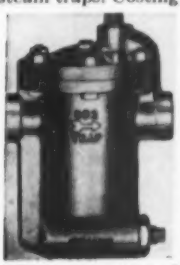
Described here are new and newly improved products. Use the Reader Service Cards on page 131 to ask for more information on them. Just circle item numbers of all the products in which you are interested.

1—CHLORINATOR incorporates new design developments

First of a series of new chlorinators to be introduced by this company, the Model A-701 is announced as having these features: dual orifice meter which automatically, or by the flip of a switch, allows feed ranges to 100 to 1; corrosion resistant materials used wherever good structural design permits; linear scale reading of chlorine flow rate; automatic electric, hydraulic, air or vacuum control. Maximum capacity of the Model A-701 will be 1000 lb per 24 hours. It utilizes a heavy fiber glass pedestal and an improved design of manufacturer's glass-enclosed visible vacuum and water diaphragm principle of feed control. Wallace & Tiernan Inc.

2—STRAINER TRAP is larger, and costs less

A larger model, No. 882, has been added to company's line of integral strainer steam traps. Costing less than a standard trap plus separate Y-type strainer, and with fewer fittings required for installation, it is designed for use where dirt and scale conditions are bad. A stainless steel strainer screen is located in the body casting at the bottom of the Model 882 Trap.



This new trap has horizontal and opposite pipe connections of ½-in. or ¾-in. size, and capacity ranges from 1300 to 2200 lb condensate per hour. Maximum operating pressure is 250 psig. Except for the built-in strainer, the trap is identical to manufacturer's No. 812 side inlet, side outlet trap. The body is cast semi-steel, with internal parts of chrome steel and stainless. It is 8 1/16 in. high, with diameter of 5 5/8 in., weighs 15 lb and costs less than $26. The strainer bushing has straight threads, and a copper asbestos gasket between bushing and body is designed to prevent rusting-in or "freezing." Armstrong Machine Works.

3—SIGHT GLASS LIQUID cuts down on the cleaning costs

Fluorochemical 101, a liquid for use in sight glasses of force feed lubricators, is reported to have long life and not become cloudy or leave deposits on the surface of the glass. It is inert, company says, and will not extract the additives used in modern lubricating oils. Colorless, odorless, non-flammable, its use is intended to eliminate periodic removal for cleaning of sight glasses of lubricators. Manufacturer says an 8-oz bottle will fill 10 lubricators of medium size. It comes in half-pint to gallon quantities. Minnesota Mining and Mfg. Co.

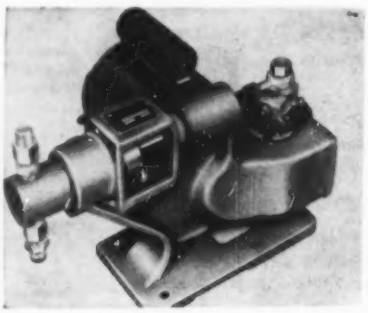
4—MOTOR for boiler feed pumps, other high speed drives

A redesigned two-pole, 60-cycle, 3600-rpm squirrel cage motor in ratings of 900 hp and larger has features particularly applicable to boiler feed service, such as new ventilation system, improved oil seal, top air intake and discharge, and increased protection for the bearing.

Noise levels are reduced by redesign of air passages and centrifugal type fans on the rotor. Interior core ventilation incorporates spiral ventilation, and is designed to avoid dirt and dust problems. According to manufacturer, this motor's air inlet and outlet have been shifted so that dirt is not sucked in to the inlet from the floor, and cleaning water can't splash into it. This new location allows room behind the yoke plates and easy access for foundation bolts, stator temperature detector terminal boards, motor leads, oil pipes. Warm air discharge is directed away from persons working around the motor. It is also pointed out that the revamped capsule bearing design prevents oil leakage in high speed operation, and the bearing housing is cored for atmospheric pressure relief so that oil vapors will not get into the machine. Allis-Chalmers Mfg. Co.

5—PROPORTIONING PUMP now has wider application

Recent improvements in the design of this manufacturer's Model 1105-S Proportioning Pump, introduced last year, are expected to still further increase its applications. Originally available only as a 10-gph pump with one motor voltage, the 1105-S is now offered as either a 10-gph or a 20-gph pump with open or explosion-proof motors, and in a variety of voltages. It can also be furnished with either standard steel and stainless trim measuring cylinder assemblies, or with these assemblies of 316 stainless steel and with ceramic plungers. Other features are self-aligning connecting rod and one-piece barstock cylinder. Bulletin 1105-S describes the new pumps. Proportioneers, Inc.



6—TEST CLIP INSULATORS come in two new colors

New color coding possibilities are afforded through the vinylite insulators used on these test clips. The insulators offer protection against short circuits and electric shock, it is stated, permitting leads to be handled "hot." Back in 1948 this manufacturer introduced the insulators in standard black and red. The two new colors are electric blue and canary yellow. Some coding possibilities

suggested are: identification of several different test leads, for marking 220-110 v three-line circuits, for easier identification of leads in semi-darkness. The blue and yellow insulators are available for company's clip sizes No. 26, 29, 47, 49, 62, 87 and 90. Free samples are offered to qualified power engineers. Mueller Electric Co.

7—VOLT-AMMETER, hook-on, with automatic scale changing

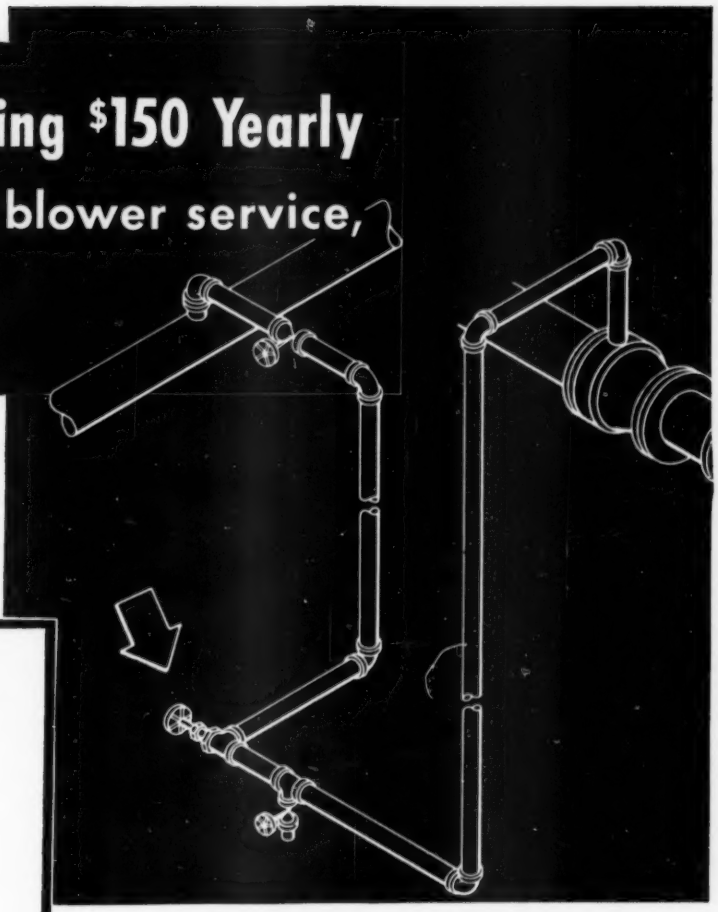
A pocket-size hook-on volt-ammeter, the AK-5, is believed to be the first with automatic scale changing. The unit is designed for quick and accurate current and voltage measurement, with the scale changer eliminating the possibility of reading the wrong scale for the application. It aids in balancing circuits, tracing

faults and grounds, estimating distribution circuits and diagnosing operating troubles.

The unit has a current range of 5/20/-80/350 amp, embracing extent of currents normally encountered in industrial circuits. It is designed to measure a-c voltage in three ranges (150/300/750) without auxiliary equipment, provide accuracy up to 3 per cent of full scale, and withstand a voltage breakdown test of 4009 v a-c. It clamps around any conductor up to 2 in. diameter, and its contoured trigger closes and opens the hook-on assembly, which is covered with insulation to help safeguard against grounding or short-circuiting. Desired range and scale is obtained by turning the unit's switch knob. Current scales are marked in black; voltage scales, in

Single Valve Saving $150 Yearly

. . . on severe ash blower service, for example . . .



The Installation

At City Light & Power Company, Washington, Indiana—with Crane bronze angle valve in 2-inch steam line to boiler ash blower manifold. Working pressure: 300 psi, 525 degrees F.

Valve Service Ratings

SUITABILITY:
Perfect match for needs

FEATURES:
Crane Plug Type Disc

MAINTENANCE COST:
One stem replaced in 3 years

SERVICE LIFE:
Already 12x former valves

OPERATING RESULTS:
Over $400 saved to date

AVAILABILITY:
Crane catalog item—No. 384P

The Valve

Crane plug-type disc and seat design make a most effective seating combination for tough steam service. Highly resistant to damage by foreign matter, wire-drawing, erosion, cutting, galling, etc. The wide tapered disc allows fine, accurate throttling. These rugged bronze valves come in globe and angle patterns; see your Crane Catalog or Crane Representative.

The Case History

Valves formerly had to be replaced every 8 to 12 weeks, their cost alone exceeding $150 yearly. It's a tough spot even for a good valve.

The valve's location in the steam line is below the boiler water level. Each operating cycle exposes it to a long leg of condensate, with an abrupt change to hot steam direct from the boiler header. On closure, the valve is again subject to cooling, and that's the cycle about 8 times daily.

Under those conditions, this Crane No. 384P Bronze Plug Type Disc Angle Valve put a stop to former replacement cost, saving more than $400 in 3 years since installed. Still the valve remains tight, dependable, and fully fit for service. That's the result of choosing the right valve—the choice assured by Crane quality and the completeness of the Crane line.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 536 on Post Card

red for easy reading. The 1¼-lb device is shock-resistant, has screw-in voltage leads. General Electric Co.

8—DUST COLLECTOR for installation in low cost housings

This new type liquid precipitating stack gas scrubber has been developed for installation in low cost housings of cinder block, concrete or fabricated steel. It is said to remove large volumes of dust from the stacks of cyclones, rotary driers, kilns, mixers and similar installations, and operating efficiency is declared such that it removes dust particles of submicron sizes even at high dust loadings. Eight models high-temperature gases in capacities from 8000 to 60,000 cfm. Of importance where water is expensive or hard to obtain, is the low water requirement of this system. According to manufacturer, only 2½ gpm at 40 to 50 psi are required per 1000 cfm.

Six dust precipitating principles are combined in the operation of this scrubber, and proportioning equipment delivers a solution called Compound M to the precipitator elements. This solution, diluted with water, wets the solid particles in the gases, and the dust which ordinarily repels water. Dust removed from the air is reduced to a watery sludge which can be discharged into a tank or pond. A recirculating system can be used where desired. Details on construction and operation of this dust removal system are available. Johnson-March Corp.

9—CONVERTER turns dry ice into CO_2 gas economically

For industries requiring a supply of CO_2 gas, the Dry Ice Converter incorporates time saving and economy features. Its operation is simple. Fifty-lb blocks of commercial dry ice are inserted into a "full opening" cylinder built to ASME specifications; then the converter is sealed by closing a door. Once sealed, the dry ice begins to convert to a liquid-gaseous state and either gas or liquid may be withdrawn. These converters come in 300-lb, 600-lb and 1000-lb capacities, and may be installed vertically or horizontally. The largest one stores 8700 cu ft of CO_2 gas which can be withdrawn at rates to 900 cfh. While storing gas the converter needs no attention, company says. Dry Ice Converter Corp.

11—MOTOR STARTER offers three-coil overload protection

For applications in which two-coil overload protection is not enough for industrial motors, this starter is designed to offer three-coil overload protection in the same enclosure and at little extra cost. An additional feature is its adjustable heater coil. You can get four different ratings from a single coil by merely changing its position, manufacturer points out, and you get motor protection within 3 per cent of usable motor load. This is said to result in more exact protection, less nuisance tripping and more usable horsepower for new or old motors. An example in which three-coil protection is suggested is on wye-delta systems where an open phase in the primary of the transformer results in one high and two low currents. If only two lines are protected, the high current line may be the one that is unprotected. Cutler-Hammer, Inc.

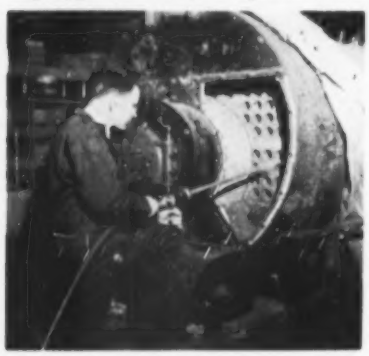
12—COMBUSTION SYSTEM is factory assembled set-up

The Thermopak Plan is a packaged combustion system developed to meet the heating and power needs of industrial and commercial plants capable of making oil burner or oil and gas burner installations on new or existing boilers with their own maintenance crews. It includes an individually engineered combustion unit with necessary controls and accessories, factory assembled ready for integration with existing boiler and service connections.

The unit, with necessary controls and accessories, converts a standard fire tube or water tube boiler (from 20 to 525 bhp maximum rating) to automatic oil-fired or combination oil and gas fired operation, using heavy fuel oil requiring preheating. The plan includes a survey of the heating plant, a custom-designed "package" to meet the requirements together with layout drawings and specifications for combustion chamber, piping, electrical work, draft control. The completely integrated unit consists of a steel platform base; extension front with secondary air damper and refractory front lining; horizontal rotary oil burner or oil and gas burner; panel box with controls mounted on top; oil preheaters. Other accessories may be furnished. Preferred Utilities Mfg. Corp.

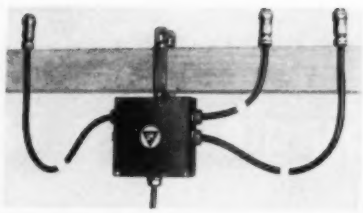
10—PERCUSSION LANCE makes an easier job of boiler cleaning

Intended to provide a quicker, more economical way to remove combustion deposits in boiler tubes, the Airnesco Boiler Cleaning Percussion Lance weighs only 5½ lb and may be operated from



any position. It operates on a minimum of 20 cfm of free air at 100 psi, or 110 lb of steam per hour at 105 psi. It is reported that in the case of flame tube boilers, even under adverse conditions, tubes may be cleaned by inserting the lance 6 in. into each tube and by simple trigger action, three or four bursts will clean the entire inner surface.

The lance is so designed that it automatically switches off the air when the plunger is released by the operator. Company says it cleans a 300-tube waste heat boiler in 30 min. Soot, clinker, and most kinds of nesting occurring on the fire side of water tube boilers can be cleared by the high-frequency action of the blasts — often without having to put the boiler out of action, it is stated. Various types of extensions adapt the tool to other cleaning jobs, as removing dust from large electric generators and trimming coal bunkers. C. F. Carpenter.

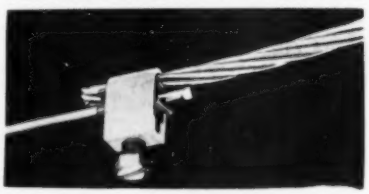


13—ASSEMBLIES for junction boxes, are factory wired

Junction box assemblies for use with NR oil switches on capacitor banks are designed to provide convenient means of interconnecting switch circuits with other control circuits, and reduce installation and maintenance costs. Each assembly consists of a cast aluminum box with a gasketed aluminum cover, a terminal block, three multi-conductor cables, and a hanger for cross-arm mounting. Each cable is terminated in a plug assembly for connection to the receptacle assembly of the NR switch. Receptacle assemblies can also be supplied. Line Material Co.

14—CONNECTORS can join aluminum to copper

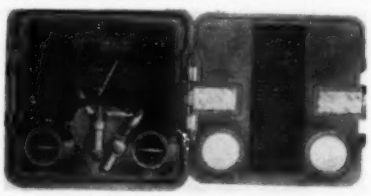
Two service entrance connectors are designed for aluminum-to-aluminum and aluminum-to-copper conductors. The bodies are extruded aluminum, cadmium plated to eliminate oxidized contact surfaces. A hex-head slotted screw is said to



make for quick and sure connections. Two spacers are used; the first, under the screw, protects the one conductor from the screw, while the second separates the conductors. Opposing spacer surfaces are grooved to line up the conductors. For aluminum-to-aluminum, the spacers are cadmium plated, while for aluminum-to-copper, two true bimetal spacers are used. The entire connection, when made up with conductors, is preponderantly aluminum. Reliable Electric Co.

15—PILOT features extra wide "throttling" range

The Type 1450 Pilot has been designed for displacement type liquid level controllers, where a torsion tube transmits float movements to reflect changes in



liquid level or a change in gravity of the controlled fluid. It has a wide "throttling" range calibrated from 0 to 100 per cent. A specific gravity index offers a method of compensating for various gravities of liquids, or for interface services, where the throttling range is kept

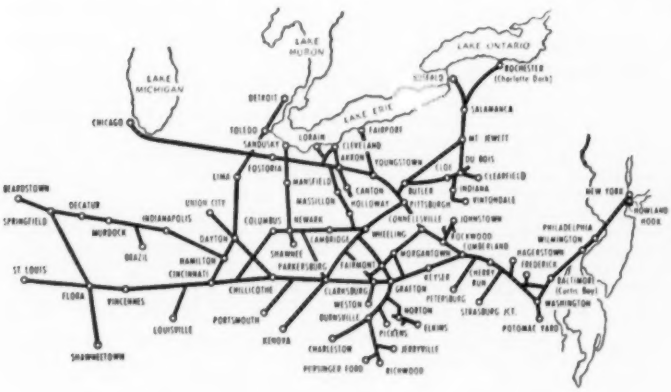
Your "burning question" is quickly answered—with

B&O Bituminous

Whether your specific question concerns power, coking, steam, or space heating, you'll find the perfect answer among the wide variety of Bituminous coals in Baltimore & Ohio territory. Here lies an almost inexhaustible source of low-cost heat and energy.

The benefits of B&O Bituminous are many. Highly mechanized mines keep production costs low, size and quality uniform. Closeness to America's industrial heart means economical transportation. The ease of storing coal eliminates the need for expensive facilities. And new methods and devices take further advantage of the burning characteristics of Bituminous.

ASK OUR MAN! He will help you find the exact coal for your purpose, and explain the best way to burn it. You'll be amazed at the efficiency, economy, and cleanliness of B&O Bituminous today.



BALTIMORE & OHIO RAILROAD

Bituminous Coals for Every Purpose

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exact in its relationship to the specific gravity setting.

Type 1450 is adjustable for "snap" or "on-off" action without requiring special parts. The amount of liquid level change from open to shut positions of the control valve may be varied up to 75 per cent of displacement element length when set for snap action, or can throttle over the full length of the element. Black, Sivalls & Bryson, Inc.

16—ALARM sounds off when separators need cleaning

A completely automatic alarm system, The Magnalarm uses lights, bells or buzzers to notify when magnetic separators need cleaning. According to manufacturer, it "does its thinking" by means of a sensitive ferrometer which constantly measures the quantity of tramp iron as it accumulates on the magnet's surface, and which reacts on a circuit to trip the alarm as soon as a predetermined accumulation is reached. Location of the alarm is optional. The separators derive their magnetic force from castings of Alnico V metal. The unit requires no wiring, no connections and minimum maintenance. Eriez Mfg. Co.

17—MOTOR PUMP for air conditioning, refrigeration use

The ¾ KRVSA Motorpump is a centrifugal pump for air-conditioning and refrigeration service. It is a single-stage, 3450 rpm unit with a keyed, cap screw type impeller attachment for positive fastening. The balanced impeller has a built-in shaft sleeve to prevent motor shaft corrosion. Standard jet pump motors ½ through 1 hp are used, and the pump will deliver capacities to 48 gpm at heads to 100 ft. A mechanical seal consisting of a rotating ceramic face against a stationary Teeplelite face is designed to prevent stuffing-box drips and eliminate motor overloads. More information is given in Bulletin 7126-D. Ingersoll-Rand Co.

18—VOLTAGE TESTER, electronic, for circuits from 90 to 600 v

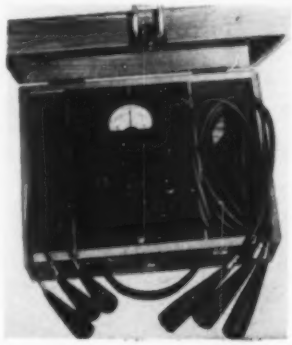
The Model AP 1 is announced as an electrical voltage tester with which there can be no mistaking a higher voltage for a lower one, for testing circuits from 90 to 600 v. By substituting an electronic means for a mechanical one, the voltages can be separated by large, easily distinguished marks, manufacturer says. The tester is made of solid plastic, is

described as more rugged, lighter and smaller than mechanical types, yet large enough to be held conveniently.

The operating section is transparent. A low voltage lights only the bottom part, and higher voltages cause the light to climb up the tube. Company says this tester will indicate voltage on all frequencies from d-c to 400 cycles on the same scale, and will indicate polarity on d-c. Also, it has such standard features as 30-in. leads of 10,000-v wire, and a place to bury the prod tips. The net price is quoted as less than $9. Craft Laboratories.

19—TESTER for determining motor and phase rotation

Designed for determining direction of rotation of electric motors before they are connected to the line, and for determining phase rotation or sequence of energized power circuits, this new tester offers a means of telling which motor



leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction. The tester eliminates the need for temporary connections, it is pointed out, and has two other important uses. It determines polarity of power and instrument transformers and can be used as a continuity tester in checking electrical circuits. Housed in an oak case, it weighs only 10 lb, and is supplied with three line and three motor leads. James G. Biddle Co.

20—PACKINGS are announced as solvent resistant

Two mechanical rod packings use a new lubricant and impregnation process for handling non-water soluble solvents such as benzene, carbon tetrachloride, turpentine, gasoline. Style 181, with braided rayon base, is recommended for pumps, valves and fittings, handling such chemicals at temperatures up to 200 F. For temperatures above 200 F, Style 1024, has braid-over-braid white asbestos base. Packing Div., Flexrock Co.

21—LEVEL CONTROL for electrically conductive liquids

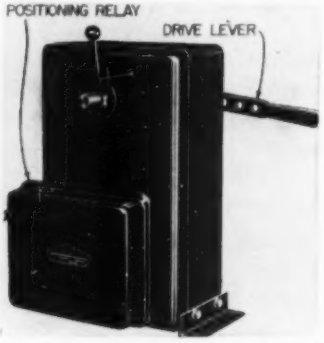
Level Control Type 13DJ3 consists of an electron tube amplifier and relay combination which operates from minute currents in the probe circuit. Except for annual replacement of an electron tube, it is said to be maintenance-free. Contact with liquid is by stainless steel probe rods, and accuracy is declared independent of temperature and pressure. A single control, through flexible terminal panel connections, provides for operation as either a pump-up or pump-down control, or a high or low level safeguard. The control is universal for either 115- or 230-v 50/60 cycle supply, according to the manufacturer.

Positive control of electrically conductive liquids results from the extremely wide sensitivity range — zero to 20 megohms per centimeter cube — over which the probe circuit operates. The Type 13DJ3 incorporates a heavy-duty relay which may be wired for double-break operation to carry up to 20 amp non-inductive at 230 v a-c or to operate directly a ½-hp motor. The control operates at a maximum probe voltage of 11.5 v for all resistivity ranges, with a current range of 6 ma decreasing to less than 1 mu a at maximum resistivity. The minuteness of these currents results in extreme sensitivity along with a high degree of safety, it is claimed, even when the pilot contacts are exposed in explosive media. The control may be located at distances up to 100 ft from the probe installation. More information is found in Bulletin PF 544. Photoswitch Inc.

22—CONTROL DRIVE is compact, improves flow control

Improved gas and liquid regulation is claimed for a small, pneumatically-operated control drive by which butterfly valves, dampers, feeders may be operated on a straight-line flow characteristic. A pneumatic signal actuates a positioning relay which, in turn, positions a piston-operated drive lever arm.

The drive is 10 by 11 by 19 in., and may be installed in any position on a column, pipe or flat surface. The drive has a 4-in. piston stroke at a torque of



75 ft-lb. It operates on standard SAMA signal ranges 3-15 and 3-27 psig; costs $210 with enclosure, positioning relay and hand operator. More information is available in Product Specifications CA040 and CA942-B. Bailey Meter Co.

23—PILLOW BLOCKS, ball bearing with steel housings

Series JPS-200 Pillow Blocks with pressed steel housings, designed for applications where speeds are relatively low and loads are light, are announced as costing less, yet giving the advantages of precision anti-friction bearing performance. Combining strength and light weight, the housings permit a cost reduction which makes them economical for light duty application. A precision deep-groove single row bearing, self aligning in all directions, assures smooth operation and long life, it is pointed out, and free-rolling action and full load capacity are maintained even with minor shaft deflection or normal misalignment. A long inner ring distributes the load over a large shaft area.

Available for shafts from ⅝ to 1¼-in. in diameter, the pillow blocks are installed easily. A synthetic rubber lip-type seal, integral with the bearing, provides sealing efficiency and excludes dirt. No further lubrication is necessary. Additional information is available in Folder 2517 which includes load ratings and dimensions. Link-Belt Co.

more Equipment News on page 126

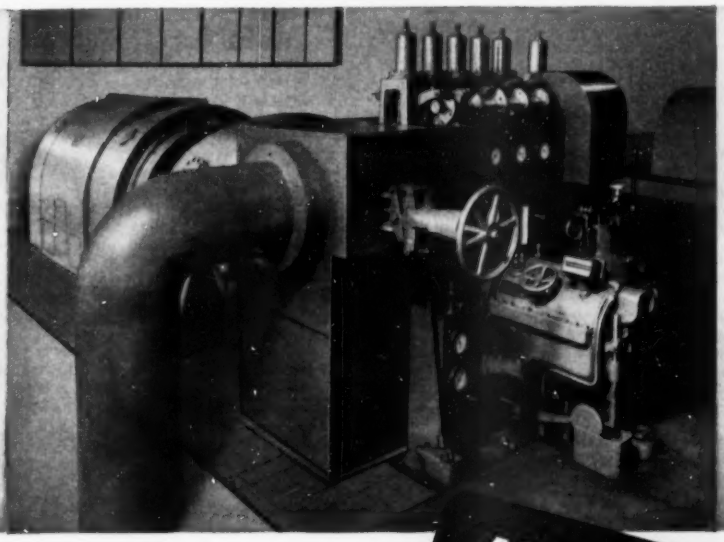
How a Southern Paper Company

Cuts Power Costs Three Ways

1
Eliminates Tube Failure

2
Reduces Maintenance

3
Cuts Blowdown Requirements



Main turbine room contains five turbine-generator units. You can get complete information on silica removal by writing for a copy of Bulletin 28R7135.

In a 33-month period, a southern paper company replaced 133 tubes and welded others. Now, after installation of Allis-Chalmers water conditioning, tube failures have been completely eliminated — along with virtual elimination of unscheduled maintenance. In addition, boilers have operated at top rating and efficiency for 12 months between scheduled cleanings. Blowdown requirements have become approximately half what they were before.

Remove Silica Content in Boiler Water

The job was done by reducing silica content 94% through use of a water conditioning system designed by Allis-Chalmers water conditioning experts. Before installation, silica content averaged 43.6 ppm. Now it averages 2.7 ppm. Equipment includes a 24,000-gph hot process softener, three 10-ft *Anthrafilt* filters, a surge tank, and chemical feeder. The system has been improved since original installation by the addition of a secondary hot phosphate unit.

ALLIS-CHALMERS
WATER CONDITIONING
Equipment — Chemicals — Service

How You Can Solve Your Water Problems

For any water problem, you'll find Allis-Chalmers chemicals, service, and equipment a useful addition to your power or process water application. Years of experience combined with a complete line of equipment enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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CONSTRUCTION NEWS

New Milford, Conn. — Connecticut Light & Power Co., 36 Pearl St., Hartford, Conn., has authorized expansion in Rocky River steam-electric generating plant at New Milford. Project will include installation of new 100,000-kw generator unit, high-pressure boilers and auxiliary equipment. Cost reported in excess of $7,500,000. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., engineer-contractor, will prepare plans and supervise construction.

Niles, Ill. — Salerno-Megowen Biscuit Co., 4500 West Division St., Chicago, Ill., crackers, cakes, biscuits and other bakery products, plans boiler house at proposed new baking plant at Niles where site has been acquired. Proposed to begin work soon. Entire project reported to cost about $1,250,000. Graham, Anderson, Probst & White, 80 E. Jackson Blvd., Chicago, architects.

Evansville, Ind. — Southern Indiana Gas & Electric Co., 20 N.W. Fourth St., has arranged financing through sale of a bond issue to total about $8,000,000, proceeds to be used in connection with 1954 expansion and development program. Work will include increased generating facilities, power substations, transmission and distribution lines and miscellaneous work.

Kern, Ind. — Olin Industries, Inc., East Alton, Ill., powder and explosives, paper specialties, cellophane, etc., plans power house at proposed new plant at Kern (Warren County) for manufacture of cellophane. A large tract of land has been purchased. Plant will comprise several production units and auxiliary structures, and is reported to cost in excess of $7,500,000. Proposed to begin work soon. Engineering department, E. I. du Pont de Nemours & Co., du Pont Bldg., Wilmington, Del., is engineer.

Logansport, Ind. — Electric Light & Power Dept. plans expansion and improvements in municipal steam-electric generating station, with installation of turbine-generator unit and auxiliary equipment for considerable increase in present capacity. Cost reported close to $3,400,000.

Great Bend, Kan. — Western Light & Telephone Co., Power & Light Bldg., Kansas City, Kan., has authorized expansion in steam-electric generating station at Great Bend. Installation will include a new 16,500-kw turbine-generator unit, high-pressure boiler and accessories. A new water-cooling tower will be installed. Proposed to begin work early in 1955, and to have plant completed about 12 mos. later. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are engineers.

Wiscasset, Me. — Central Maine Power Co., 9 Green St., Augusta, Me., has engaged Jackson & Moreland, 31 St. James Ave., Boston, Mass., consulting engineers, to prepare plans for expansion in Mason steam-electric generating plant at Wiscasset, previously mentioned in these columns. Work will include installation of new turbine generator and accessories, high-pressure boiler and equipment for oil-firing. Proposed to begin work in near future with completion scheduled by close of 1955. Cost reported about $7,000,000.

Natick, Mass. — Carling Brewing Co., 9400 Quincy St., Cleveland, Ohio, is reported planning new brewery at Natick, where large tract of land has been acquired. Project will include a steam power plant in conjunction with a group of one and multi-story production buildings. Entire program will represent a reported investment of about $20,000,000.

Minneapolis, Minn. — Northern States Power Co., 15 South Fifth St., has arranged for sale of a block of common stock, totaling about $17,000,000. A considerable portion of proceeds will be used for expansion and improvements in power plants and system, including extensions in generating facilities, power substations, transmission lines and miscellaneous work.

Biloxi, Miss. — Mississippi Power Co., Gulfport, Miss., has preliminary plans under way for new steam-electric generating plant near Biloxi. Installation will include turbine-generator unit of large capacity, high-pressure boilers and accessory equipment. Entire project reported to cost about $15,000,000, with switchyard, power substations, transmission lines, etc.

Butte, Mont. — Montana Power Co., Butte, has arranged a construction program for 1954 to cost about $20,000,000, including generating stations, transmission lines, power substations and miscellaneous work. Program will include completion of a third generating unit at Kerr hydroelectric power plant.

Ogalla, Neb. — Consumers Public Power District, 1452 25th Ave., Columbus, Neb., has plans maturing for new steam-electric generating plant at Ogalla. Installation will include turbine-generator, high-pressure boiler and auxiliary equipment. Cost estimated over $2,000,000. Details of installation will be determined soon. Fay E. Smith & Associates, 821 Brentwood Rd., Omaha, Neb., are consulting engineers.

Roseland, N. J. — Bloomfield Tool Corp., 46 Farrand St., Bloomfield, N. J., large precision tools and parts, special machinery, a subsidiary of Walter Kidde & Co., Inc., 675 Main St., Belleville, N. J. (fire extinguishers), plans steam power house at proposed new plant on 65-acre tract of land at Roseland. It will comprise a main one-story structure and several auxiliary buildings, approximating in all about 61,500 sq ft floor space. Cost about $1,000,000. Work will begin soon. Walter Kidde Constructors, Inc., 140 Cedar St., New York, N. Y., will prepare plans and supervise construction. (First noted company is changing name to Kidde Precision Tool Corp.)

Westville, N. J. — The Texas Co., Westville, plans extensions in steam-generating plant at local oil refinery, with installation of new boiler unit with rating of 275,000 lbs of steam per hr, and auxiliary equipment, including water-cooling apparatus. Work will be carried out in connection with a large expansion and improvement program at refinery. Reported to cost in excess of $5,000,000. Main offices are at 135 East 42nd St., New York, N. Y.

Columbus, Ohio — Columbus & Southern Ohio Electric Co., 215 North Front St., has arranged an appropriation of about $23,000,000 for expansion and improvements in power plant and system during 1954. Of this amount, approximately $10,000,000 will be used for extensions in Picway and Poston steam-electric generating stations, with installation of additional equipment for increased capacity. Remainder of fund will be used for power substations, transmission lines and other field construction.

Dayton, Ohio — Dayton Power & Light Co., 25 North Main St., has arranged an expansion and improvement program in plants and system during next 24 mos., to cost about $22,750,000. Of this amount, approximately $12,250,000 will be expended during the remainder of 1954. Work will include increase in generating facilities, power substations, transmission lines and miscellaneous construction.

Lorain, Ohio — Ohio Public Service Co., Lorain Division, Lorain, has authorized expansion in local Edgewater steam-electric generating plant. Work will include installation of a new 90,000-kw generator unit, high-pressure boiler and auxiliary equipment. Proposed to begin work next fall and to complete project in early fall of 1957. Program is estimated to cost about $16,000,000, including switching station, power substations, transmission lines and miscellaneous structures.

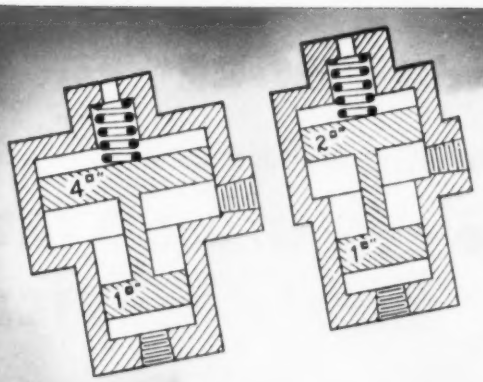
Napoleon, Ohio — Campbell Soup Co., 100 Market St., Camden, N. J., is projecting plans for new canned-soup products plant near Napoleon. It will consist of several production units, with steam power house. Entire development will total about 800,000 sq ft floor space, and is reported to cost in excess of $4,000,000.

Ellwood City, Pa. — Townsend Co., River Rd., New Brighton, Pa., rivets, studs, wire nails, etc., plans boiler house at proposed new plant at Ellwood City. Production unit will approximate 80,000 sq ft floor space. Proposed to begin work during summer. Cost reported in excess of $800,000. Joseph F. Bontempo, Baker Bldg., Rochester, Pa., is architect.

New Bethlehem, Pa. — Crawford Furniture Mfg. Corp., Allen St. Extension, Jamestown, N. Y., bedroom furniture, plans boiler house at proposed new factory at New Bethlehem where site has been secured. It will comprise a main one-story building, about 200 x 200 ft. Cost reported over $200,000, with equipment. Reliable Engineering Co., 2605 Beale Ave., Altoona, Pa., is architect and engineer.

Corpus Christi, Tex. — Central Power & Light Co., 120 North Chaparral St., is reported planning installation of additional generating units in future, at new generating plant near Corpus Christi, recently placed in service, with an initial capacity of 66,000-kw. It is understood that extension program will mature within 24 to 36 mos.

Menasha, Wis. — Menasha Electric & Water Utilities, 809 Broad St., will have plans prepared by Stanley Engineering Co., Muscatine, Iowa, consulting engineer, for proposed expansion in municipal power plant, recently noted in these columns. Work will include installation of a 7500-kw turbine-generator; high-pressure boiler, with rating of 90,000 lbs of steam per hr, and accessory equipment. Cost reported approximately $1,600,000. Proposed to carry out work during summer.



Do You Know Why 'HIGH RATIO' TRAPS *by* NICHOLSON DRAIN CONDENSATE FASTER?

IF you were asked, "Which of the two differential pistons sketched above will require the least pressure drop before the piston assembly can move up?" you would obviously answer, "The one at the left". Because of the higher ratio between the areas of its upper and lower pistons.

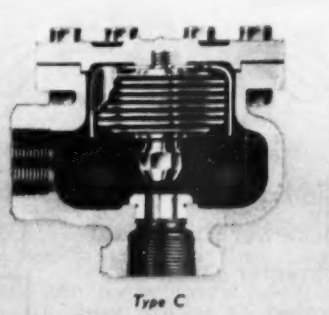
Now the line pressure in a thermostatic bellows trap is analogous to that in a differential piston. The higher the ratio of bellows area to discharge orifice area the less the pressure drop required before the bellows will contract and open the discharge valve.

Getting down to cases, the Nicholson thermostatic trap has a larger bellows than any other trap of this type, while its discharge valve orifice is approximately equal in size to any other trap. This gives a higher ratio and causes the Nicholson trap to operate on the least temperature difference between steam and condensate.

Now take the case of two traps with discharge valves of equal size and assume that they are operating at a given temperature difference.

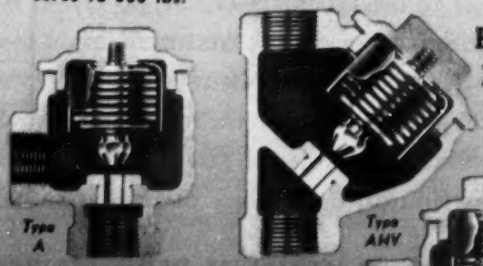
The Nicholson "High Ratio" trap will open its valve wider and have larger capacity than the low ratio trap.

This is a reason why a Nicholson thermostatic trap operates faster and keeps a unit full of live steam. And, may we add, it's one of the advanced features that are influencing plant engineers increasingly to standardize on Nicholson.



The two types above are semisteel; sizes ½" to 2"; pressures from vacuum to 250 lbs. Type C also in cast steel for pressures to 300 lbs.

FIVE TYPES FOR EVERY PLANT USE



These three types are bronze; sizes ¼" to 1"; pressures from vacuum to 200 lbs. All five types have stainless steel valves and seats; bronze, monel or stainless steel bellows.

Send for NICHOLSON TRAP CATALOG 953

Catalog 953 contains capacity tables, installation diagrams, and data, charts and formulae for determining the proper size trap.

W. H. NICHOLSON & CO.

160 OREGON ST., WILKES-BARRE, PA.

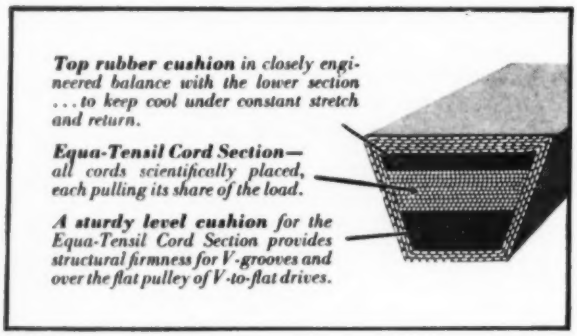
Sales and Engineering Offices in 53 Principal Cities

For more data circle 539 on Post Card

Handles MORE Horsepower... the new U. S. ROYAL SUPER-SERVICE BELT

Meet the *toughest* V-belt in the "U. S." Line. Delivering 40% more horsepower than standard belts, it also absorbs greater shock loads. Ideal where space is limited or where you want to decrease the number of belts required in order to use stock sheaves.

U.S. Royal® Super-Service is a "natural" for troublesome drives, especially heavy shock-load drives. High tensile strength, minimum stretch. All standard multiple sizes. Order from your distributor, or call any of United States Rubber Company's 25 District Sales Offices or write to address below.


Top rubber cushion in closely engineered balance with the lower section ...to keep cool under constant stretch and return.
Equa-Tensil Cord Section— all cords scientifically placed, each pulling its share of the load.
A sturdy level cushion for the Equa-Tensil Cord Section provides structural firmness for V-grooves and over the flat pulley of V-to-flat drives.

A COMPLETE DRIVE SERVICE

MULTIPLE V-BELTS • F. H. P. V-BELTS • SHEAVES
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UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

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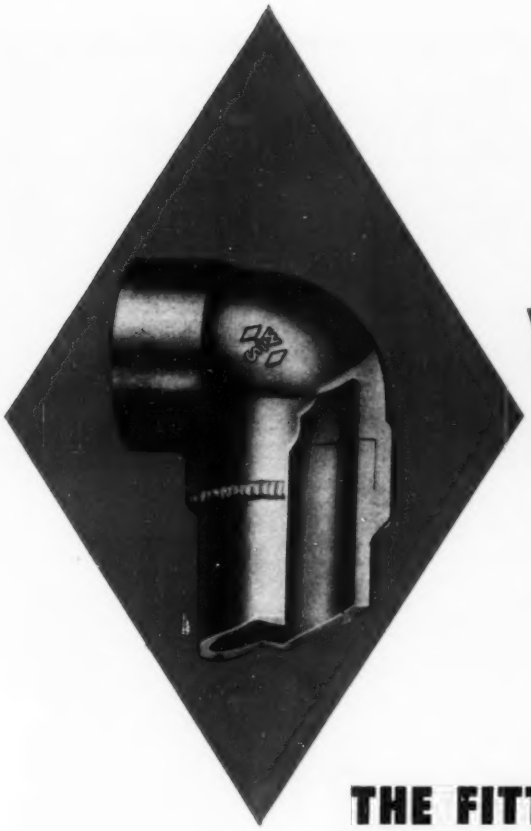
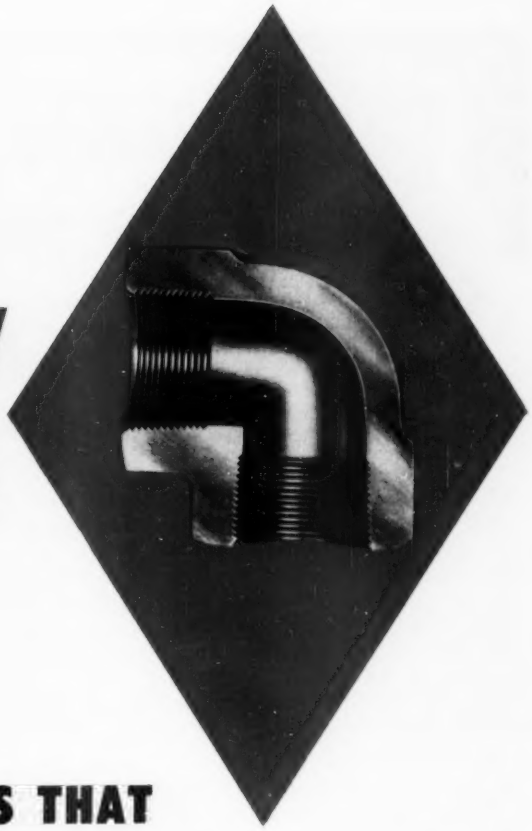
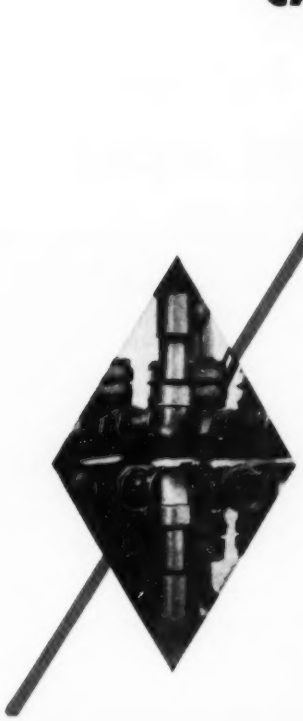


W-S



THE FITTINGS THAT CAN REALLY TAKE IT!



Every elbow, tee and cross in a high pressure piping system is a point of concentrated stress. W-S Forged Steel Fittings take this tough service in stride because they're fabricated and designed to resist pressure, heat, shock and vibration. They're drop forged of highest quality steel to produce a dense, tough, forged-fiber structure that can really take it. And careful heat treatment after forging develops the metallurgical properties of the steel to their fullest.

Notice, too, how Watson-Stillman engineers have designed extra strength into the fittings. Long bands extend well beyond the threads or sockets to provide extra reinforcement. Wall thickness is carefully calculated to put extra metal at points of severest stress.

W-S high-precision machining and rigorous inspection follow through to give you the fittings that mean stronger, tougher pipe joints. W-S Forged Steel Fittings are available in both Screw-End and Socket-Welding types in carbon, stainless and alloy steels.

Sold Through Leading Distributors

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

For more data circle 541 on Post Card

Looking for the right packing for your centrifugal pumps?

For shaft speeds to 1750 RPM Johns-Manville Centripac seals better

WEAR on centrifugal pump shafts as well as on oscillating and rotating rods of other equipment is minimized by J-M Centripac. This is because the square cross section of this packing provides the maximum contact surfaces. Thus, it insures a tight seal with the least friction and gland pressure.

Because Centripac is plaited square it retains its shape indefinitely, thus maintaining maximum surface contact for long periods of time. It is made from long-fiber asbestos yarn, thoroughly lubricated and graphited. It seals against fresh or salt, hot or cold water, oil, ammonia, brine, gasoline, and certain weak acids and other chemicals. Because of its wide application, it is a favorite of plant men everywhere.

For general service, Style #7 Centripac is recommended. It contains no wire, is soft enough to conform readily to the packing space, and stands up well in service. It comes in coil form, Style #C-7 and Ring form, Style #R-7. Sizes 3/16" and up.

For higher shaft speeds, J-M Plastic Packings reduce friction and scoring of shafts and sleeves

Higher centrifugal pump speeds make friction increasingly important in packing and shaft life. That is why J-M Plastic Packings have been designed to have the homogeneous structure and low friction so essential to long packing life in this service.

The exact composition of these packings varies according to the service conditions for which each particular style is designed. As an example, one of these, Style No. 610 is an excellent general maintenance packing for service against steam, air, ammonia, gases, etc. up to 550F. It is made of selected asbestos fiber mixed with pure graphite and a small amount of non-friction metal, then bonded with a heat-resisting compound to form a pliable coil or spiral. It is furnished in sizes of 1/8" and up.

YOUR J-M PACKING DISTRIBUTOR will gladly recommend the right packing for your equipment, and furnish it from stock for your immediate requirements. Write Johns-Manville, Box 60, New York 16, N. Y. for his name and address. In Canada, 199 Bay St., Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS and GASKETS

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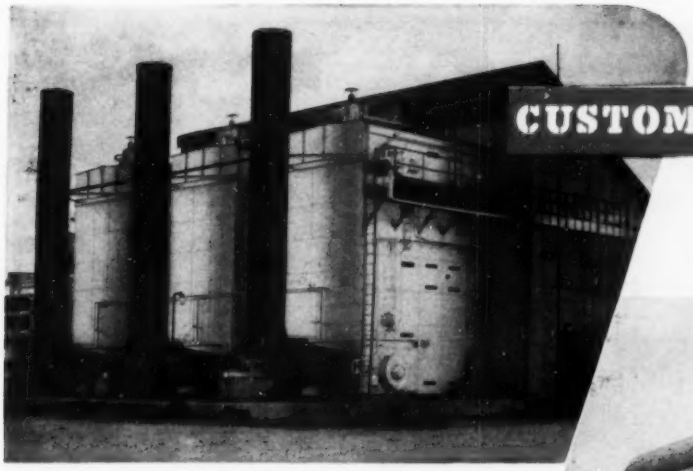
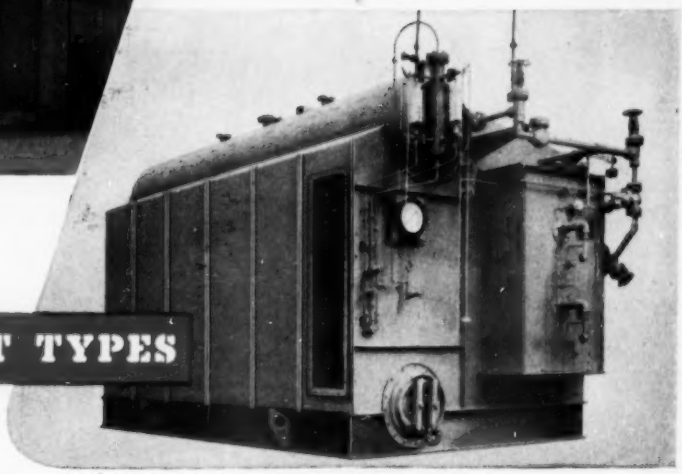


CUSTOM BUILT TYPES



PACKAGE UNIT TYPES

Stop 'n Shop at Vogt

for modern Steam Generators

Types and Sizes for Every Power, Processing and Heating Requirement

Steam costs too high? Then it's high time to replace outmoded boilers with modern Vogt steam generators of the type and size to exactly fit in with specific operating conditions.

Vogt steam generators are designed to give maximum rating in minimum space, with high efficiency and low maintenance expense. They are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid or gaseous fuels burned singly or in combination.

Package units range from 10,000 to 30,000 pounds capacity and custom built units are obtainable in the larger capacities. Many installations in successful operation are proof of Vogt's ability to give effective help in the solution of steam generating problems. Bulletins may be had upon request.

HENRY VOGT MACHINE CO.

LOUISVILLE, KENTUCKY

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, [illegible]

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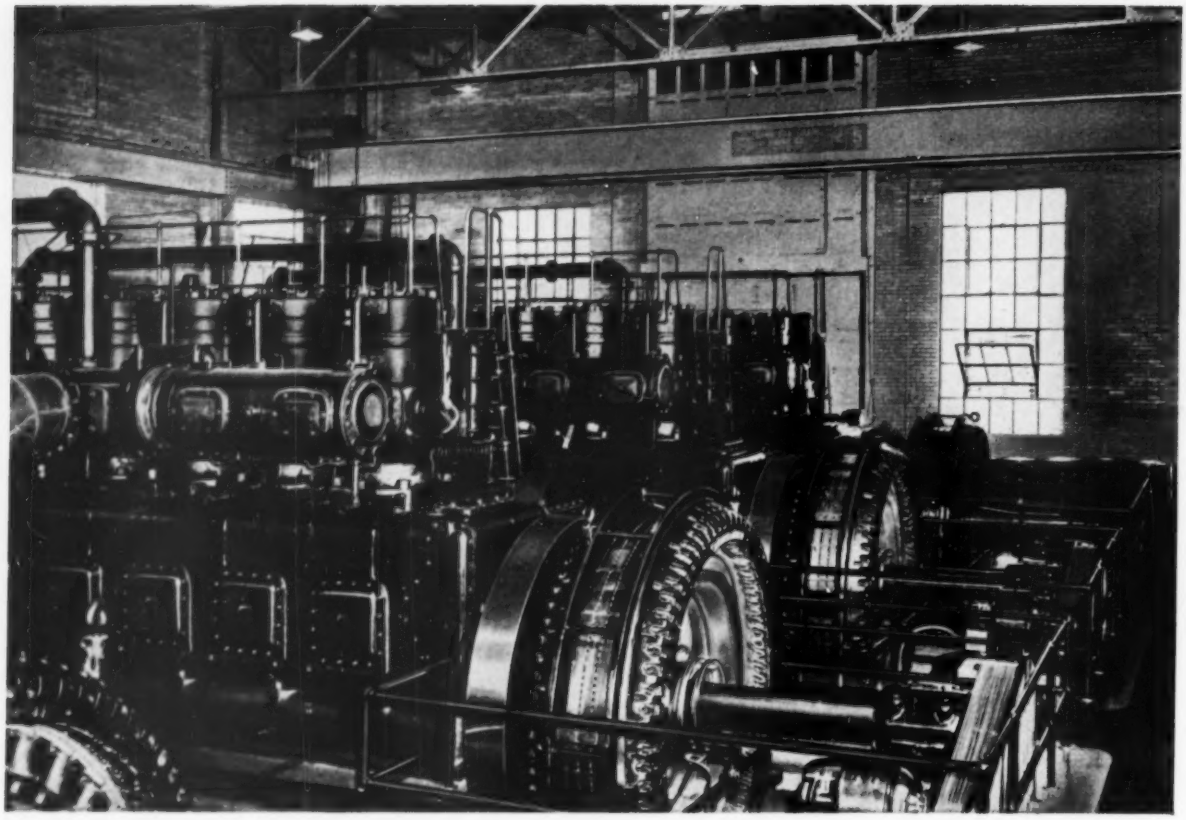

"We're Proud of This Plant!"

says Don H. Decker, — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity*. Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save Wear and Replacement

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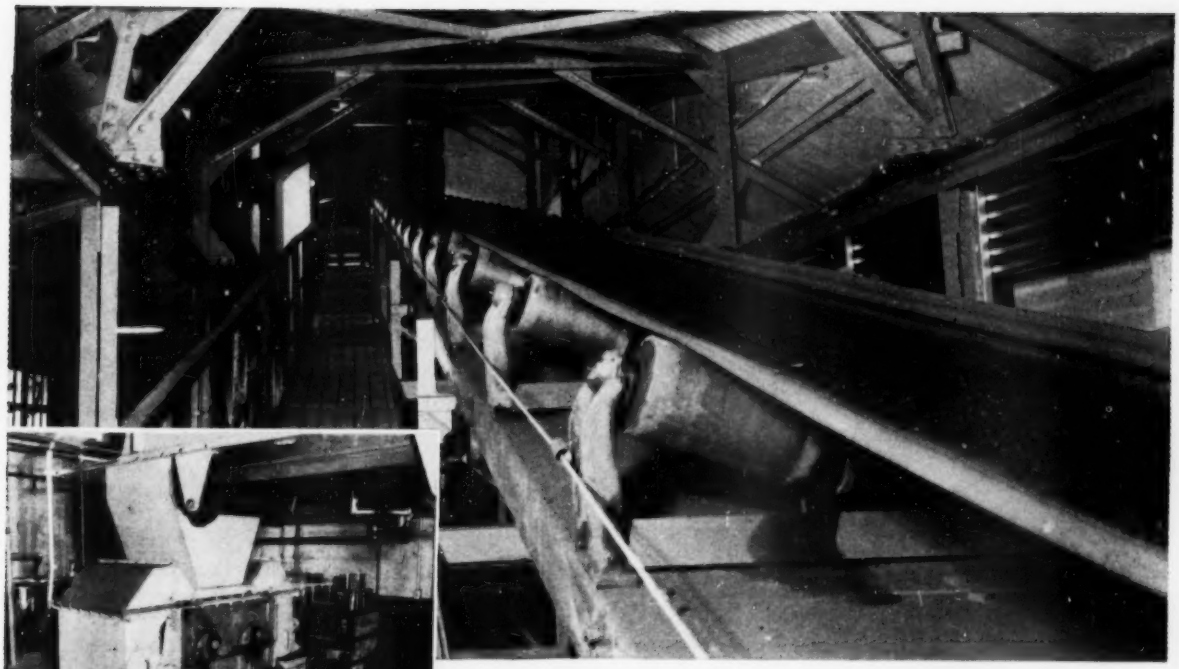
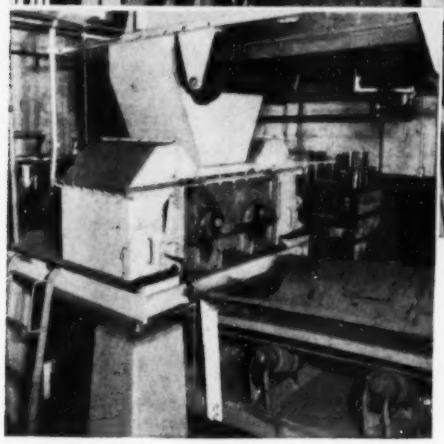
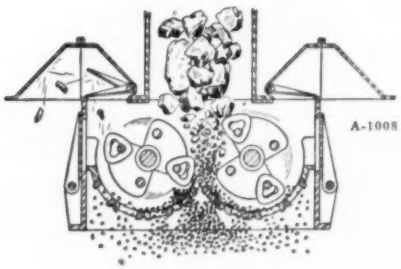


Two 17-inch loop boot double leg REDLER elevators, operating in very limited space, feed crushed coal to the 30-inch slope belt shown above. This belt, handling 200 tons per hour, feeds a cross belt conveyor that delivers coal to twin shuttles.



Above: 18" x 24" double rotor Knittel crusher. Cross section shown below demonstrates how wet coal delivered from track hoppers is crushed without clogging. Steel fingers lift independently to take out uncrushable material without stopping crusher. Costly shutdowns for cleaning are unnecessary and capacity is maintained.



"Tailor-Made" Coal Handling System Moves 200 Tons Per Hour in Limited Space

"Fit the system to the job and meet limitations of existing buildings and structural plant conditions", were the big problems S-A engineers faced when they designed a system for handling coal for this power plant. Fast, low-cost crushing and conveying were additional requirements.

High capacity crushing of coal is done by two 18" x 24" double rotor Knittel crushers. Coal falls to two short belt conveyors feeding two 17-inch loop boot double leg REDLER elevators. These two REDLERS operate in a very limited space yet handle 100 tons per hour, each. The coal is lifted 76 feet and fed to slope belt conveyor shown in photo. The slope belt runs through a gallery and discharges to a 30-inch reversible belt which can feed either one of two 30-inch shuttle belts. The shuttle belts are 81 feet long and self propelled.

When you consider any changes or additions to your present conveying system, ask to have an S-A engineer go over the problem. He can find the low-cost solution for you to meet demands of limited space or *any other need*. He works with a complete line of bulk materials handling equipment — is backed by the experience and resources of the full S-A engineering organization.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

86 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

Engineering Division

Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division

A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division

A complete line of industrial ball bearing units available in both standard and special housings.

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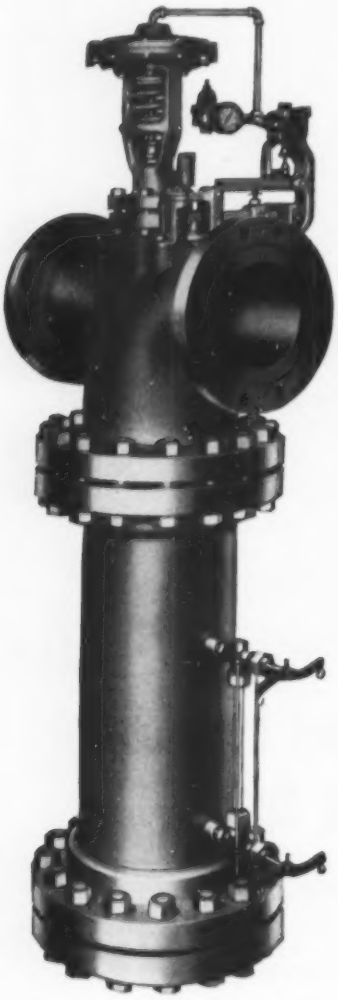
Designed ONLY for the TOUGH JOBS

BUILT FOR PERFORMANCE . . . NOT DOWN TO PRICE!

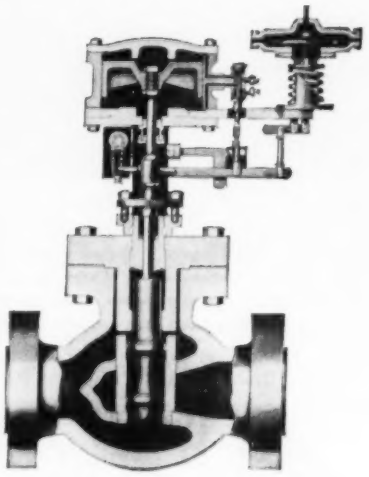


WHEN you select your pressure reducing and desuperheating station, you'll pay more if you buy COPES. But if your job is a tough one, you'll find COPES cheapest in the long run. You'll be money ahead in installation, operation and maintenance costs, and you'll be getting *accurate* control—even down to your lightest loads, not just at your normal flows.

You'll get *quiet* operation—avoiding annoying chatter and destructive vibration.

You'll get 'round-the-clock dependability for years to come—with any adjustments or maintenance easily handled by your plant personnel.

It all adds up to the kind of performance you need for your tough jobs—results you cannot expect if you buy on price.



COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

The COPES DESUPERHEATER

You'll find it easy to install the self-contained COPES Desuperheater. It goes into the line as a unit, with only three connections. All accessories are furnished. You need no extra steam atomizing valve with extra stop valves—no long run of alloy-steel steam piping—no extra piping from the temperature element to the spray nozzle—no other extras.

You'll also find your COPES Desuperheater correctly sized for low velocities—for minimum noise, vibration and wear. You'll find temperature control accurate—even on lightest flows—because cooling water is controlled and completely atomized inside the mixing chamber. Adjustment is simple and permanent.

The COPES REDUCING VALVE

You'll find your COPES valve ports accurately designed for the correct capacities under the flow and pressure conditions you specify. You'll have no "hunting" to upset the precision of your control.

You'll find extra-heavy construction throughout. The valve piston is supported and guided in the areas subject to greatest velocities and forces. If these forces could cause excessive erosion, Stellite is welded to all contact surfaces before they are precision-ground to correct clearance for your installation. You'll find design and construction minimizes the possibility of sticking, leaking or vibrating. You'll suffer no objectionable noise.

ENGINEERED BY THE MAKERS OF COPES FEED WATER REGULATORS

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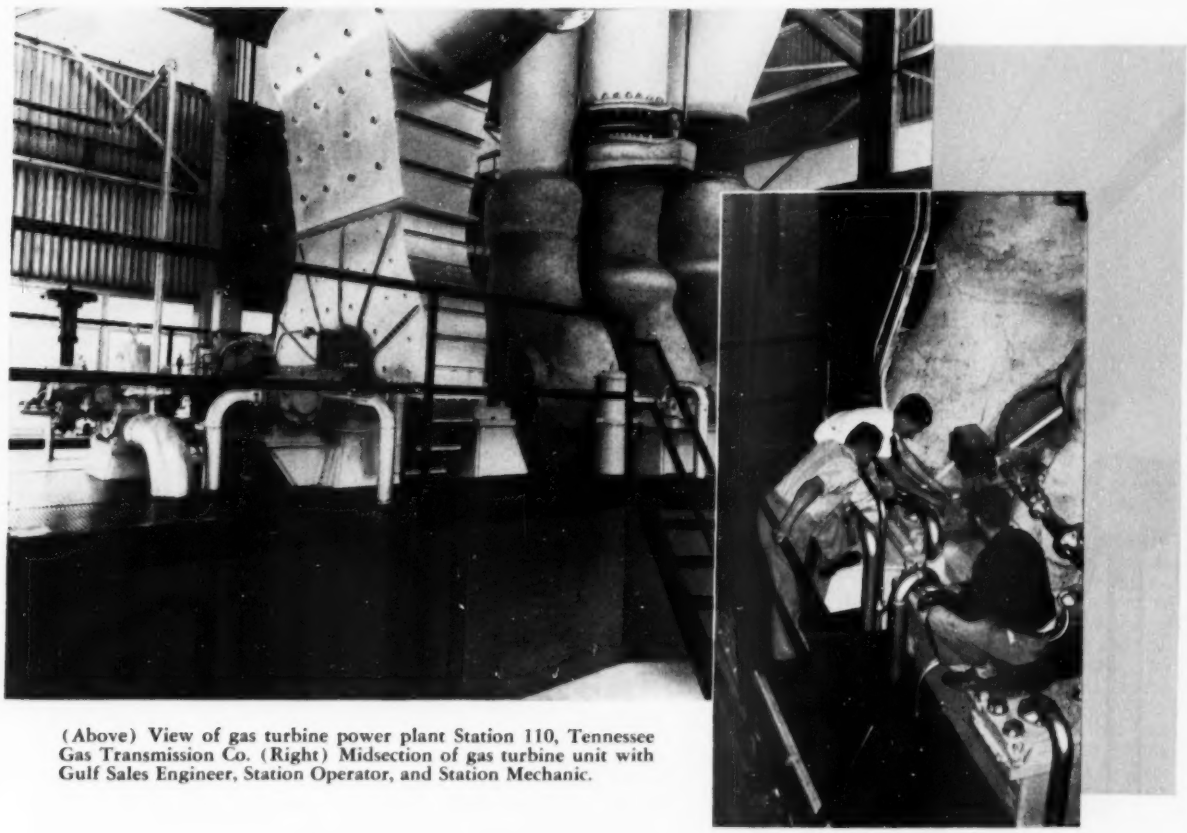
IT'S GULFCREST OIL

FOR **GAS** TURBINES, TOO—



(Above) View of gas turbine power plant Station 110, Tennessee Gas Transmission Co. (Right) Midsection of gas turbine unit with Gulf Sales Engineer, Station Operator, and Station Mechanic.

Shown above is a new type of gas turbine pumping unit in operation during the past year at the Morehead, Kentucky Station of Tennessee Gas Transmission Company.

To help protect its investment in this modern equipment, Tennessee Gas Transmission Company uses Gulfcrest Oil for the lubricating system. And this great oil is doing the fine job expected of it.

To hundreds of progressive utilities, the name Gulfcrest means outstanding quality and long life, as well as the sure protection so important to continuous, dependable operation. Super-refined by Gulf's exclusive Alchlor Process, Gulfcrest is the world's finest turbine oil!

Call in a Gulf Sales Engineer and ask him to recommend the proper grade of Gulfcrest for your turbines—gas or steam. Write, wire, or phone your nearest Gulf office.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION
GULF REFINING COMPANY
1822 Gulf Building
Pittsburgh 30, Pennsylvania

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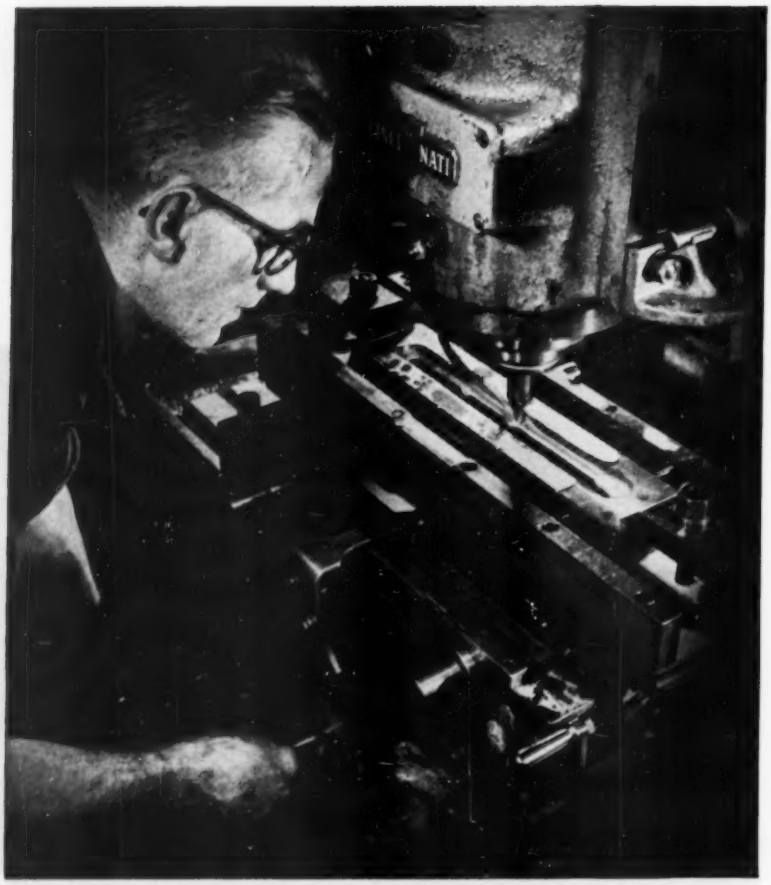
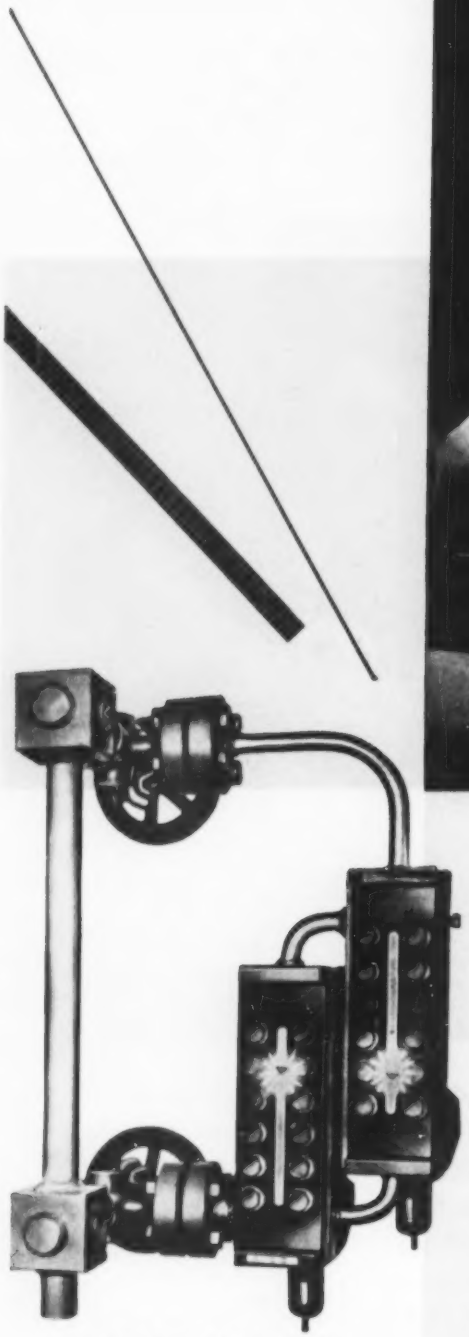




Yarway High Pressure Boiler Water Gage with separated-design flat glass inserts. Write for Yarway Bulletin WG-1812

HE'S A SPECIALIST ON STAINLESS STEEL INLAYS

● A dentist? No.

He's a Yarway craftsman. In the picture above he is milling a gasket groove in the stainless steel facing that is used for this important part of a high pressure boiler water gage body.

The man is important; so is the inlay.

The man is typical of the skilled workmanship that goes into every Yarway gage, blow-off valve, steam trap or other product —workmanship that makes no compromise with quality.

The stainless steel facing is typical of advanced Yarway engineering design. That inlay is but one of twelve basic improvements made in Yarway high pressure water gages.

When buying boiler water gages as well as other steam plant equipment, measure the cost in terms of good engineering, quality, workmanship, and dependable service.

"*Make Yarway your way.*"

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
REMOTE LIQUID LEVEL INDICATORS
EXPANSION JOINTS
DIGESTER VALVES
STEAM TRAPS
STRAINERS
SPRAY NOZZLES

For more data circle 548 on Post Card

New Exciter Omits Commutator

This revolutionary development in exciter design eliminates brushes and commutator by generating excitation current as high frequency a-c and then rectifying it to d-c for use in the field circuit. The rotor, which is the only moving part of the machine, has no windings, so the maintenance needed is negligible

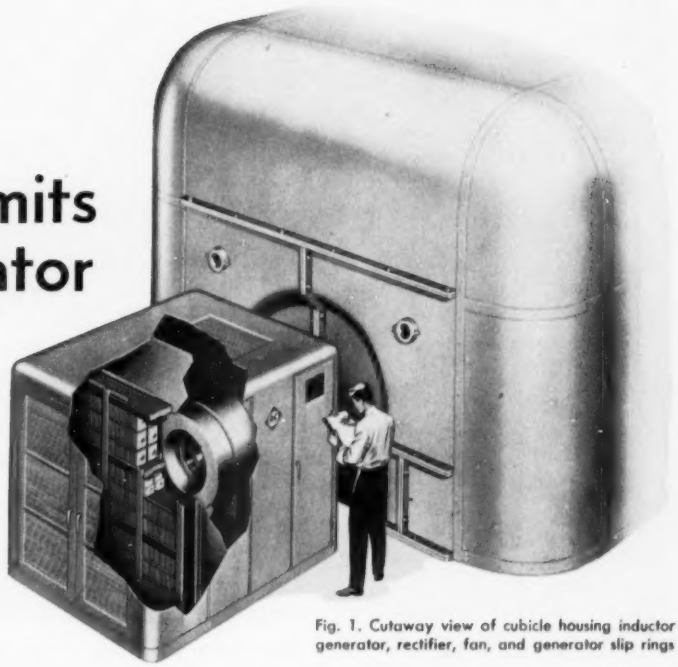


Fig. 1. Cutaway view of cubicle housing inductor generator, rectifier, fan, and generator slip rings

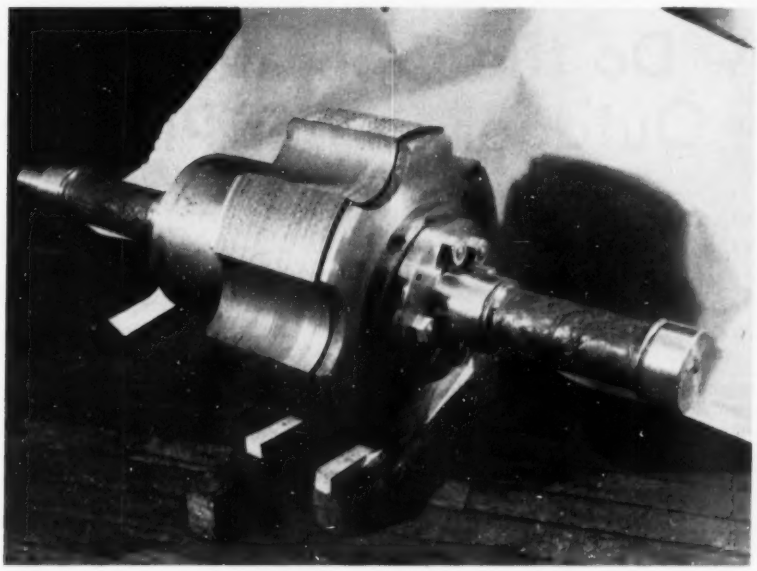


Fig. 2. Rotor and stub shaft for 125 kw, 200 v, 3600 rpm inductor generator for main field excitation

NEW EXCITATION SYSTEM announced by Allis-Chalmers, eliminates brushes, commutator, and rotating windings of the conventional d-c exciter. Power for excitation is generated at high frequency by an inductor generator and then changed to direct current by a bank of selenium rectifiers. The inductor generator is the only piece of equipment having moving parts, and since its rotor, as shown in Fig. 1, has no windings on it, the maintenance required by this system is practically negligible compared with that required by conventional exciters.

The inductor alternator is under the control of magnetic amplifiers through a circuit sensitive to the main generator terminal voltage. Generator frequency is 360 cps. The inductor generator has inherently high reactance and is especially sensitive to lagging power-factor loads. Because the exciter has in effect no time constant of its own, the speed of response as a factor delaying restoration of voltage is governed mainly by the very short time constant of the magnetic amplifiers.

The rotating element of this new exciter is adaptable to overhung mounting on most 3600 rpm generators, in which case couplings, gears and extra bearings are eliminated and apart from the inductor generator, only static components are used.

Perhaps the most interesting advantages of this new development are that two of today's major causes of steam turbine generator outages, commutator maintenance and brush replacement, will be eliminated.

The first of these new exciter systems will be installed soon by Allis-Chalmers on a 43,750 kva, 3600 rpm machine at Iowa Power and Light Company, Des Moines.

Figure 2 shows what the new exciter will look like. The 6-ft high exciter cubicle will house the inductor generator, with its direct mounted centrifugal fan, the slip rings of the main generator, and the selenium rectifier bank. In this cubicle, which is designed to match the existing generator, a compartment separates the rectifier from the generator.

With this arrangement the rectifier uses the same cooling fan as the exciter. However, the rectifier does not have to be adjacent to the exciter, and if required, it may be mounted separately some distance away.

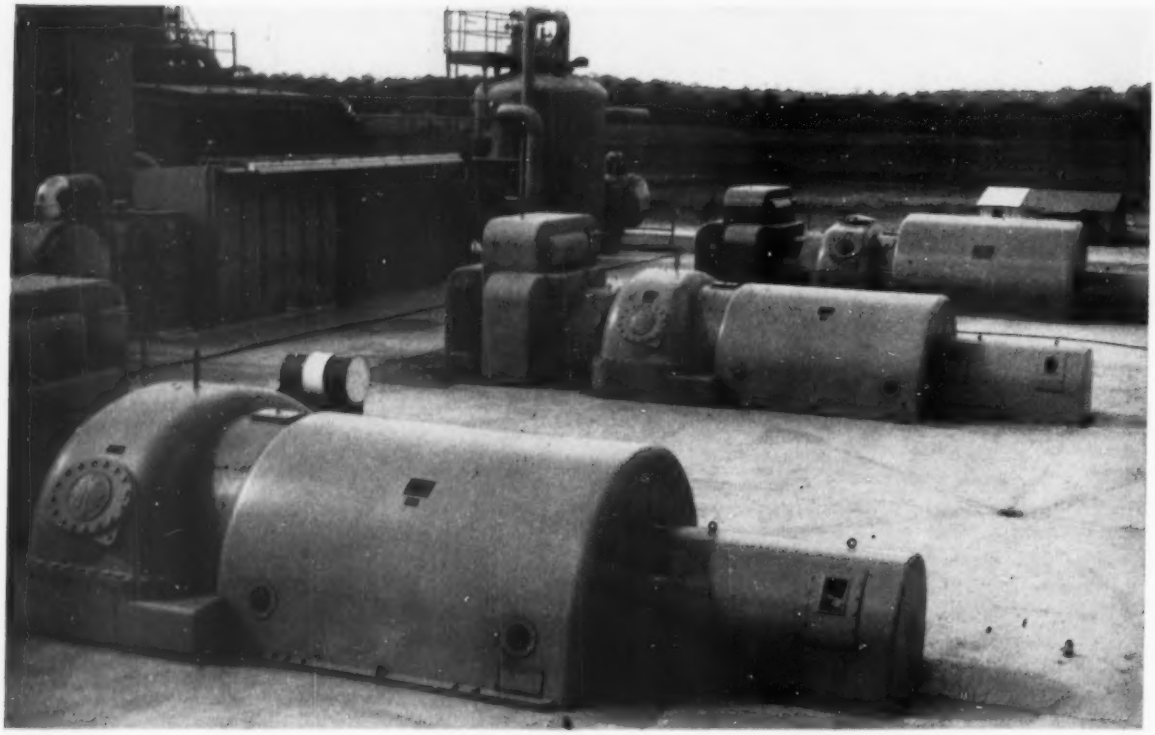


Fig. 1. There is no doubt about exposure to the weather in these stations, and conditions for operators can be very different from those in indoor stations

How Do the Operators Like Outdoor Power Plants?

Most of the discussion, pro and con, about outdoor power plants deals with engineering or economics. But what about the men who operate these plants? Do they find them too hot? too cold? too wet? too dusty? too difficult to maintain? Here are some answers from several of the companies who operate these outdoor plants

ONLY A FEW YEARS AGO, most of the arguments about outdoor power plants concerned their practicability — whether or not an outdoor plant could be operated with any degree of reliability. While the argument has been going on, utilities have been quietly building and running these plants, and accumulating operating experience. The effect of this experience was shown at a recent ASME panel discussion on outdoor power plants. There the arguments were not whether these plants were practicable, but with the comparative advantages and disadvantages of outdoor plants. In other words, the outdoor plant has come to stay. The question now is not whether it is practical, but whether it is better than an indoor plant in a particular situation.

Most of the arguments dealt with engineering and cost problems. Only a few words were said about the problems of the operating staffs who run these stations. However, many people who are prepared to accept quite easily the idea of machines operating satisfactorily in the open find it more difficult to believe that operating personnel can do the same.

To indicate how personnel do react to outdoor plant operation we have summarized some of the discussion dealing with operation and maintenance from the point of view of the men who actually run these plants.

Experience gained by the Salt River Power District, Arizona, from their Kyrene Steam Plant was presented by Messrs. T. M. Morong, C. T. Eyring, and J. O. Rich, Jr. Their contribution to the discussion included the following:

"We have found that the extreme temperature variations have resulted in more colds and an increase in time off for operating personnel, over an older conventional installation.

"The operator's satisfaction, however, is very high at this plant. Operators have turned down chances for advancement when such advancement required their returning to an older conventional installation. Supervisors at the plant also feel very satisfied with the design and operating experience to date. We have also had a good reaction from our maintenance personnel, working both indoors and outdoors at this location."

On the other hand, M. K. Drewry, Chief Engineer of Power Plants, Wisconsin Electric Power Co., pointed out some of the drawbacks of outdoor plants in the colder climate in which his company operates. They have found that low-cost enclosures made of asbestos siding have advantages over conventional indoor plants and also over completely outdoor sta-

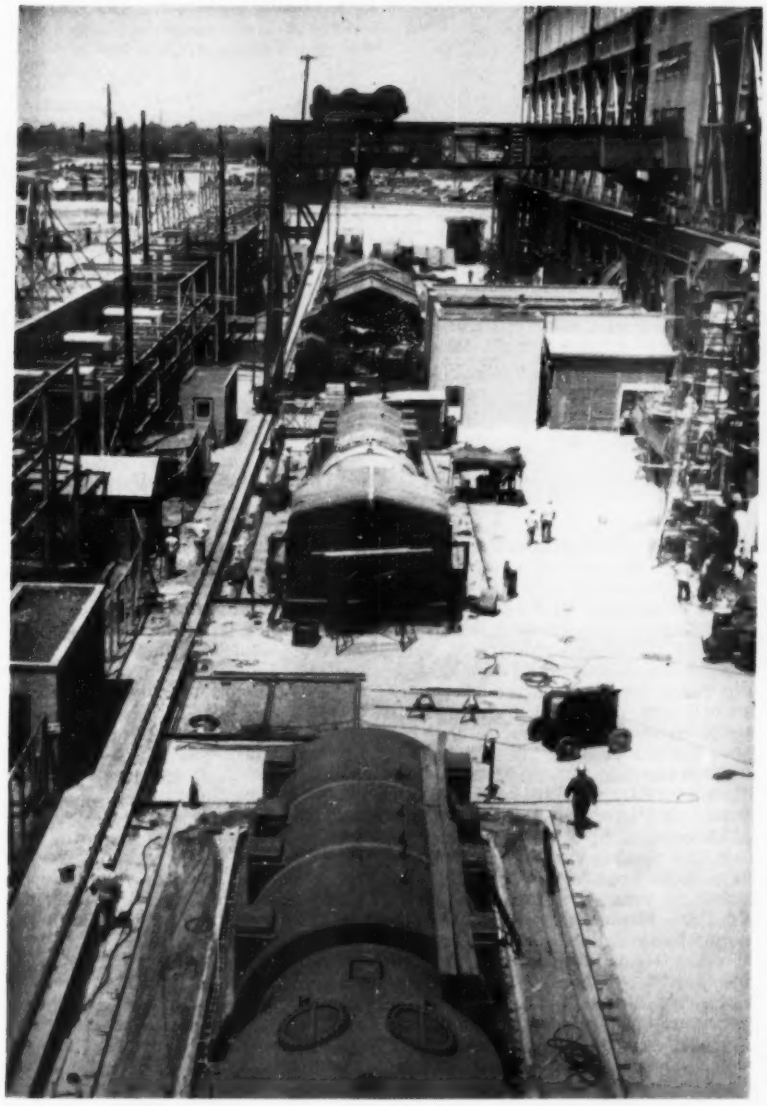


Fig. 2. Joppa, under construction, shows type of temporary protection for outdoor station equipment

tions. He continued with the following remarks:

"Simply the boiler-room comparison is cited because there seems no adequate inducement to take the long chance of needed turbine maintenance in mid-winter in this climate without complete turbine-room shelter.

"That outdoor construction is a necessary defense against destructive turbine oil fires may be stated in favor of omitting shelter. However, in the above case, shelter costs include favorable isolation of the oil system of each unit, effectively permitting other units to continue in service and helpfully providing adjacent walls through which to fight the fire. That this isolation system solves the problem better than does outdoor construction seems a fact.

"Outage time is usually impressively expensive. An extra day per year of the above-mentioned unit is as costly as $60,000 added investment. Thus, if unfavorable weather prolongs outages a total of 1⅓ days per yr, the $80,000 incremental cost for roof and walls can be paid, with the heat saving computed above left as a net gain.

"That the question of indoor-versus-outdoor power plants is one of geography and circumstances and one that will probably never have a simple answer is suggested. For northern states our company's experience suggests that inexpensive shelters are well warranted. Heat savings paid 94 per cent of their cost in a recent case. The substantial gains of importantly facilitating construction and maintenance that enhance the availability of the expensive apparatus are net savings of no little magnitude."

Some interesting informationon the importance of good housekeeping for the operation of outdoor plants in dust storms was given by C. W. Geue, Supt. of Power, Texas Electric Service Co. He said:

"The request for information on operating difficulties with outdoor plants in dust storms posed a problem, since we found it difficult to find any serious cases of trouble that could be traced to dust storms. From 3 to 5 years experience with outdoor steam electric generating station in West Texas, during one of the worst droughts in history, has definitely shown that no serious operating or maintenance problems are caused by dust or sand storms. It is very likely that had these stations been completely enclosed, the dust and sand nuisance would have been worse, since dust and sand would have accumulated in the enclosed areas.

"Aside from the nuisance of these dust or sand storms we have not found any distinction between operating an indoor or outdoor plant under these conditions. The key operators are in an air-conditioned control room and others are in sheltered areas. Clear glass goggles are available to assist operators in seeing properly while inspecting equipment during a severe sand storm.

"Good housekeeping is necessary in any plant whether indoors or outdoors. The following minor problems have come up in outdoor stations which would also occur in indoor type of plant located in areas where dust storms are prevalent:

"1. Leaky oil seals on motor bearings will result in an accumulation of oily dirt on the motor windings. Pressurizing these seals eliminated the problem.

"2. Grease and oil on valve stems, regulator valve stems, and reciprocating pump shafts, etc. will catch sand or grit and result in more rapid wear and leaky packing.

"3. Some sparking and more rapid wear of brushes on commutators and collector rings have been noted during severe sand storms, especially so in one case where a high wind blew dust into the exhaust air duct from the exciter hood. This was corrected. Protection of exciters is such that they are as well enclosed as in indoor plants and the dust nuisance has not had any more effect on this equipment than if the machine had been indoors.

"4. During maintenance, severe dust storms may stop work on exposed machinery, which must be covered to protect bearings, journals and open oil lines from sand. Careful cleaning of such parts afterwards is very important.

"5. Auxiliary power switch cubicles should be made dust tight.

"Summarizing our experiences, we have not had any operating problems that could not have been prevented by good housekeeping."

A different opinion on cold weather

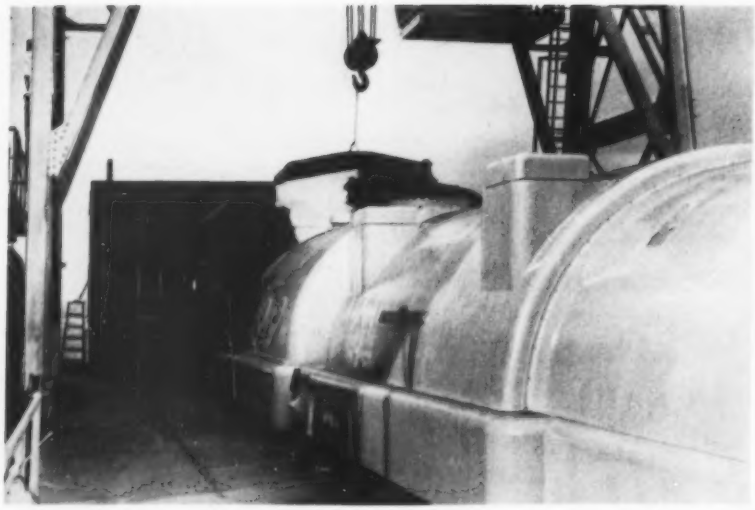


Fig. 3. Frank W. Bird Station's turbine generator, showing housings over governor and exciter, control room at end. Temperature here goes to —40 F

operation was expressed by R. A. Reid, Supt. of Generation, Montana Power Co. in discussing the F. W. Bird Plant originally described in the April 1951 issue, additional data in March 1953 issue. He said:

"On the point of the relative cost of maintenance in comparison with an indoor plant, we doubt if cold weather, while admittedly disagreeable, is much of a handicap or that it increases the maintenance costs. Men are more productive in cold weather than under hot conditions. The cost of rigging canvas enclosures is not excessive, due to sufficient structural steel members around the boiler from which temporary enclosures can be hung, such as for soot blower maintenance, etc. As for maintenance inside of the boiler proper, the stored heat is sufficient for two or three days work even in the coldest weather. Outdoor painting costs may be increased somewhat but probably will be offset by the fact of not having extensive turbine and boiler enclosing structures to paint.

"The first winter's operation of this first steam plant on a previously all-hydro system presented some difficulties for operating and maintenance personnel with no previous steam experience. However, an outdoor plant in this climate is practical. The problems encountered were mainly due to lack of previous design experience for Montana weather conditions and operating inexperience. It is believed that our difficulties have been overcome."

Even hurricanes were brought into the picture by H. G. Hiebeler, Asst. Supt. of Power, Houston Lighting & Power Co., in the following:

"The completely outdoor plants here have been tested by only one hurricane of comparatively short duration, although the older outdoor boiler units have experienced major storms. Heavy driving rains give frequent fairly complete short-time tests. No difficulties have been experienced. Of course, the indoor stations during a tropical storm are not exactly as snug and tight as those who have not enjoyed such experience might imagine. Large ventilator windows necessary for summer cooling are almost impossible to make tight against rain and 100 mph winds, and in consequence water may be showered down on equipment not designed for such contingency."

Most of the companies who operate in hot, dry climates report that operating personnel prefer service in outdoor plants to the conventional indoor type. Typical is the statement by W. L. Chadwick Chief Engineer, Southern California Edison Co.

"There has been distinctly better operator morale at the outdoor station. Operators prefer the outside duties, often resisting transfers to assignment on which they will be required to work in enclosed areas.

"One objection frequently raised to outdoor stations is the exposure during overhaul and repair. Our experience has been that some form of temporary, portable housing is essential yet quite satisfactory. During initial alignment of the units such housing is necessary to prevent uneven expansion from uneven solar heating.

"After erection, the shelter can be set aside, but still used to enable any necessary maintenance work to be continued during unfavorable weather. We do not believe that any walk-in enclosure is desirable because it would provide no protection which cannot be obtained in a weather-proofed unit, yet it presents the same problems in ventilation and much the same exposure to hazard from fire and accidents as in fully enclosed stations.

"We believe that the outdoor station design is a natural step in the development of the central station. The first electrical apparatus was all housed, but as designers and manufacturers improved equipment, advantage has been taken of the economy, reliability and safety which may be gained by moving the generating, transforming and distributing stations outdoors."

New Bark-Burning Boiler at Mobile

NEW bark-burning boiler has been completed at the Mobile, Alabama, pulp and paper mill of Hollingsworth & Whitney Co. The boiler is a single-pass boiler with swaged tubes.

The boiler was built by Combustion Engineering-Superheater, Inc. according to specifications of the engineering department of Hollingsworth & Whitney Co.

Boiler plant building and accessory layout was designed and constructed and the boiler was installed by The Rust Engineering Co.

The new unit represents a distinct improvement over older methods of burning bark for steam generation, being one of the first of its type to utilize a new method of firing that gives practically complete combustion with a minimum of excess air and consequent high efficiency.

Instead of pile or grate burning, the bark is shredded and introduced to the furnace through a high set spreader stoker. The bark is largely burned in suspension after passing through a zone of direct-contact evaporative drying. Turbulence nozzles inject air to help keep the bark in suspension, and firing is under full automatic control.

Furnace consumption is estimated at 53,000 lb per hr of bark (at 50 per cent moisture) in combination with natural gas. When barking drums (supplying the bark) are not operating, the furnace is carried full load on gas. Oil can be used as a standby for the gas.

In firing, automatic controls base load the boiler by adjusting the natural gas to make up any deficiency in the bark that is available at any instant, and proportion the air between bark and gas to burn both efficiently.

Design capacity of the boiler is 130,000 lb per hr of steam when fired by bark, 160,000 lb per hr on gas, and 160,000 lb per hr when fired by combination of fuels, of which 100,000 lb per hr is produced by bark.

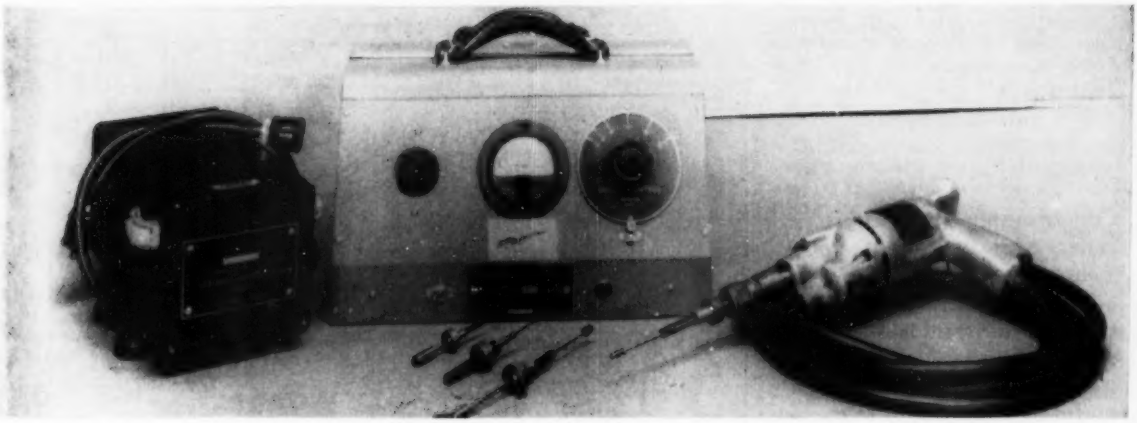


Fig. 1. Here is the equipment for electronic tube expanding. Transformer on left, electronic control set, standard electric drill, and variously-sized expanders

You Can Expand Your Tubes Electronically

However skilled a man is, he can't be sure of applying just the right pressure on a tube expander. Here's a new control using a thyratron tube circuit to give exact expanding force every time

Fig. 2. Electronically-controlled expander on test

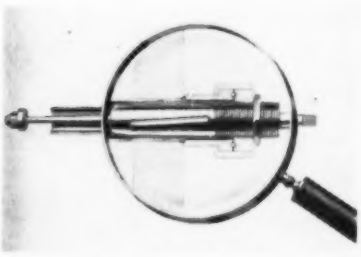


Fig. 3. A commonly used parallel-rolling expander

AS TEMPERATURE and pressure conditions become more severe in modern heat transfer equipment, the art of expanding tubes has to keep pace with this progress. This is particularly true for tubes expanded at both ends with metal-to-metal joints. Overexpanding imposes excessive cold-work stresses in tubes and sheets, resulting in early failures. Underexpanding leads to leakage and non-productive hours for correction in the field. Dr. F. E. Dudley, in ASME Paper No. 53-A-133, presented in New York in December 1953, describes the progress made in methods of expanding tubes during the last few years, with special emphasis on a new electronic control for precision expanding.

Principle of operation is as follows. A small part of the current taken by the expander drive motor is passed through a potentiometer to the cathode of a thyratron tube. By adjusting or setting the potentiometer, the thyratron tube can be made to spill over at any pre-determined amount of current which will be drawn by the expander-drive motor.

When the thyratron spills over, current is supplied to a relay which trips out the motor, and so stops the expanding operation at exactly the right point. From the characteristic curve of the motor, the amount of torque necessary to expand a given size tubing can be easily determined by merely converting amperes to ft lbs of torque.

When the amount of torque necessary to expand a given size tubing has been determined by setting the potentiometer selector dial, the same torque will be developed at any future time and ensure the same result.

Need for this type of equipment was emphasized during the development period when tests were conducted, using an operator who had been expanding tubes for a period of 20 years. The tube-sheet plate was mounted in a vise, at work-bench height, which afforded ideal conditions for consistency. Tests were then conducted to obtain push-out values for the tubes that had been expanded into the test sheet. These values were found to vary from 1750 lb up to 5880 lb.

Expanding of stainless steels has been of much concern in industry because of their cold-work phenomena. Stainless-steel tube ends which are to be expanded should be fully annealed. Hole clearance of the OD of the tube should be held to a minimum.

Lubrication for the expanding of tubes should be of the water-soluble type.

These electronic-tube expander controls are now available commercially, and they are finding increasing use for expanding condenser tubes and similar power engineering applications.

Of great interest to the heat transfer industry is a United States Navy Training Film entitled "Maintenance and Repair of Steam Condensers, Water Circulating Side." Dr. Dudley was the technical adviser while this film was being made for the Navy.

This film will be loaned without charge to firms who are interested. It is 16 mm, black and white, sound, and runs for approximately 25 minutes. For more information write to the Editor, POWER ENGINEERING.

Contamination of waters in refineries is such that treatment is necessary whether re-using it or discharging it to a stream. Treatment must reduce color, adjust pH and remove oil and related compounds, and it must be cheap in quantity. Such a treatment system is described in this brief article

By V. J. CALISE *

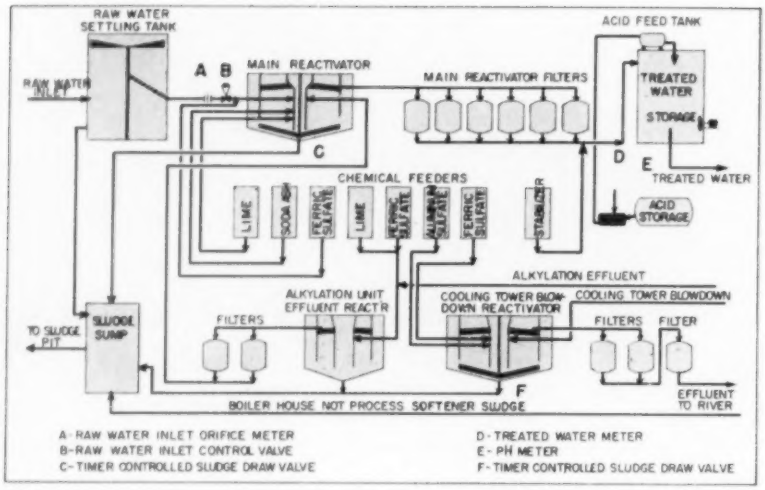


Fig. 1. Flow sheet of sludge-absorption process plant serving a Southwestern refinery. Installation produces an acceptably clean effluent for discharging to a stream, a greater purity for re-use in the refinery

How to De-Oil Your Refinery Waste Waters for Economical Re-Use

TREATMENTS prescribed by the Committee on Disposal of Refinery Wastes, of the American Petroleum Institute, for the removal of unemulsified (free) oil from refinery wastes are generally satisfactory. Occasionally, however, problems involving the re-use of such waste waters in drouth areas arise and will require a lower concentration than can be obtained with mechanical or physical separation, especially if those waters are to be used in boilers as feedwater.

These techniques are also unable to separate water-soluble wastes from refinery effluents, such wastes resulting from the reaction of sulfuric acid on petroleum distillates or residues. Such reactions produce sulfonation products of alkylated aromatics and olefins which, depending on structure and molecular weight, are soluble in water and/or oil.

Most of the oil-insoluble, water-soluble sulfonates, together with the spent acids, separate from the treated oil in the form of sludge, and efficient methods are available to dispose of this sludge by conversion into sulfuric acid and coke. Unavoidable spills, periodic cleaning of equipment and the purification process for oil-soluble petroleum sulfonates, will occasionally lead to the presence of water-soluble sulfonates in the waste water originating at the units which are concerned with these operations.

Depending on its source, this type of waste water is either acid or alkaline, contains dissolved sulfonic acids and sometimes emulsified oils, and is of dark color. Successful treatment must, therefore, result in proper adjustment of pH, reduction of color, and substantial removal of oil. It has been found that all of these aims can be achieved by acidifying the waste water, if it is alkaline, and precipitating the major portion of the sulfonates with lime. This procedure is combined with flocculation by means of ferrous sulfate if the addition of lime does not achieve the desired color reduction. After settling,

* Director, Research and Development, Graver Water Conditioning Company

Table I. Effect of sludge on oil removal from a refinery waste water containing petroleum sulfuric acid

Sample No.	H_2SO_4 Added ppm	Lime Added ppm	Ferrous Sulfate Added ppm	Sludge Added ppm as $CaCO_3$	Colors		Oil		Oxygen Consumed	
					Before	After	Before	After	Before	After
1	—	400	90	—	5,000	150	40	5	120	30
2	—	400	90	2000	5,000	20	40	<2	120	<5
3	200	300	80	—	1,500	55	3300	40	430	55
4	200	300	80	5000	1,500	10	3300	10	430	20

Table II. Analysis of typical waters of Southwestern refinery showing the condition (in ppm) at 4 phases

	River Water	Raw Water from Settling Tank	Treated Water	Net Effluent
Dissolved Solids	2,810	3,340	3,490	11,300
Total Hardness	500	357	128	512
Calcium Hardness	410	280	69	320
Magnesium Hardness	90	77	59	192
Phenolphthalein Alkalinity	0	68	85	.....
Methyl Orange Alkalinity	154	225	159	.....
Chlorides	1,145	1,400	1,400	5,020
Oil	0	250	20	Nil
Sulfates	....	....	....	2,660
Ammonia ion	....	....	....	313
Cresols	....	....	....	Nil

Table III. Details of the treatment for each of the 3 subsystems comprising the refinery's treatment plant

System: →	Main	Cooling Tower Blowdown	Alkylation Unit Effluent
Maximum rate (gal. per. minute)	1200	140	20
Water source	Trap & river water	Cooling tower blowdown	Alkylation unit
Purpose	Softening	Clarification & Sulfide Removal	Lime pit Neutralization & fluoride removal
Chemicals Used	Lime Soda Ash Ferric Sulfate	Ferric sulfate Aluminum sulfate	Lime Ferric sulfate
Treater size (diameter of Reactivator)	45 ft., 0 in.	13 ft., 6 in.	7 ft., 4 in.
Filters containing anthracite (number and diameter)	Six, 10 ft., 0 in.	Two, 5 ft., 6 in.	Two, 3 ft., 6 in.
Disposal of Water	To treated water storage tank; to cooling towers as makeup.	To river	To main treating system.

the treated water can be discharged into a stream.

Basically, the treatment consists of precipitation of salts and removal of additional coloring matter by adsorption on an iron hydroxide floc. In many cases, the calcium carbonate and magnesium hydroxide precipitates formed are good adsorbents of oil and effectively remove the oil present in the waste water. No additional floc is required for oil removal.

If ferrous sulfate treatment is required, experience indicates that optimum decolorizing and settling can be obtained by bringing the water to pH 10 with lime before ferrous sulfate is added. The final pH of the treated water, regardless of whether lime alone or lime and ferrous sulfate is used, is frequently found to be about 8.4 since optimum settling is obtained under these particular conditions.

Treatment Details

Briefly summarized, the treatment procedure can be given as follows:

1. Adjust the several waste waters to pH 5.
2. Add hydrated lime and adjust pH to a minimum of 8.
3. Contact with precipitates formed by lime and compounds in the water.
4. If decolorization and settling are poor in step 2, adjust pH to 10 or 10.5 (or predetermined optimum value), and add ferrous sulfate with the possible reduction of pH to about 8 or 8.5.
5. Settle the precipitate.
6. Release settled water at a controlled, slow upward rate.

Table I shows typical results of this procedure applied to a waste water containing petroleum sulfonic acids in laboratory beaker tests. These data show the effect of proper contact with adsorbent precipitates in reducing color and oil content of a particular waste water.

A flow diagram of an existing cold process lime treatment and clarification installation, plus some other equipment, now in successful operation in a Southwest refinery as shown in Fig. I.

Originally 1500 gpm of oil-contaminated waste water was discharged into a small stream. As a result of the installation and operation of the equipment, about 300 gpm are discharged as clarified waste and 1200 gpm are re-used in the refinery after further treatment to soften and remove oil. Data taken from this plant are reported in Tables II and III.

Sludge is Burned

In this plant, concentrated oily sludge obtained from the process is burned to avoid lagooning. Chemical operating costs average 4.3 cents per thousand gallons. Savings obtained by re-using clarified water come to several dollars per day; but the main benefit is the freedom from reliance on a stream which is adversely affected by drouth and the elimination of pollution of that stream with oily wastes.

Though this article has dealt exclusively with the sludge absorption process, processes employing air flotation are used in some cases when the specific conditions indicate their use. While the sludge absorption process is definitely effective, as illustrated here in reducing color, oil and organic matter in surface water supplies and in waste waters, detailed studies are required to justify a system selection.

Editor's Note: A previous article on water de-oiling by this author appeared in April issue, pages 86 and 87.

Locomotive Compressor for Emergency Instrument and Control Air

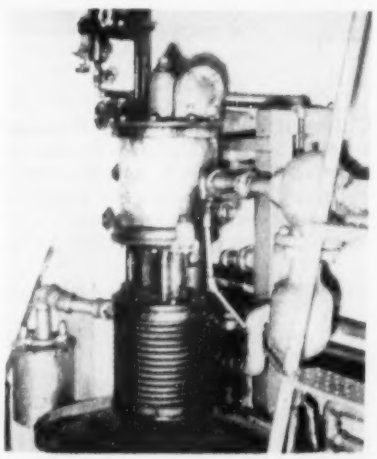
BY CARL TRETINYAK *

MANY POWER PLANTS that use compressed air for combustion controls and other air-operated controls, depend primarily on electrically-driven air compressors. Shutdowns which cause loss of electrical power also leave the plant without control air unless special gasoline or steam-driven compressors have been installed for this service.

One power plant solved this control air problem at little expense by obtaining a piston-type air compressor from a junked steam locomotive. The compressor unit (see illustration) was mounted on the wall of the power plant with suitable brackets. Steam to the steam cylinder of the unit was controlled by a diaphragm-type steam valve which throttles the steam as pressure in the air receiver increases. In this manner, the speed of the compressor is held in close relation to the air flow demanded by the control mechanisms.

Lubrication is supplied the cylinder walls by pressure lubricators which meter the required amount into the air and steam cylinders.

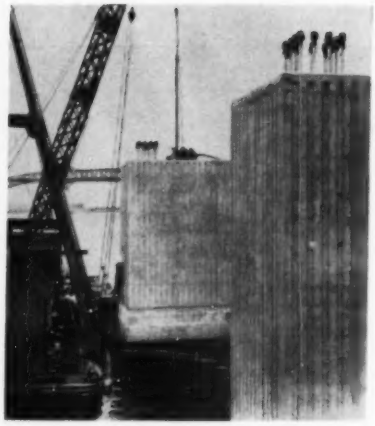
One advantage of this type compressor is that it will supply a large amount of air quickly in an emergency. In this particular installation, it was found that the compressor would operate on 50 psi steam pressure, although it was designed originally to be installed on a 250-psi locomotive.



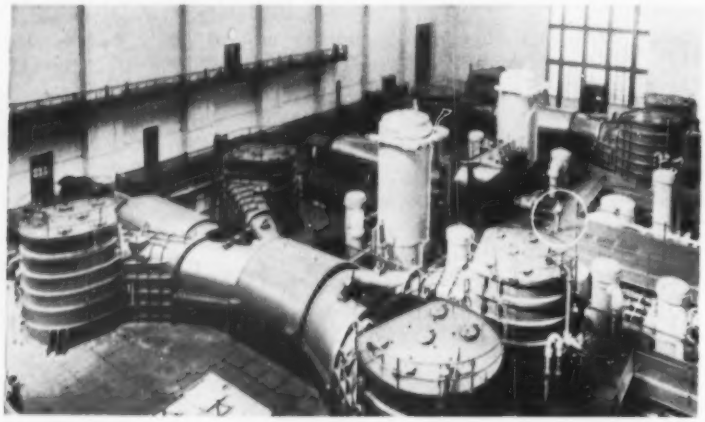
Wall-mounted steam-driven air compressor pirated from a junked steam locomotive for emergency air

*Chief Engineer, St. Mary's Hospital, Rochester, Minn.

Power Engineering's NEWS REEL

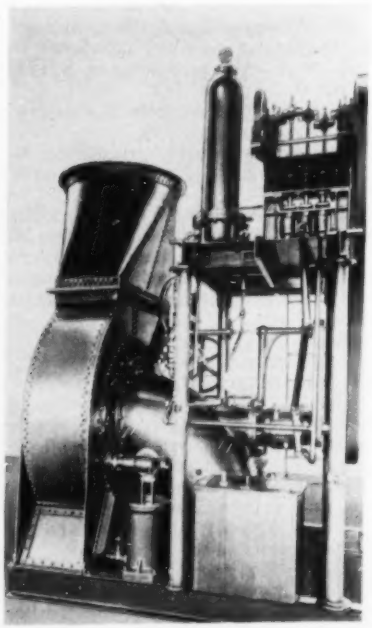


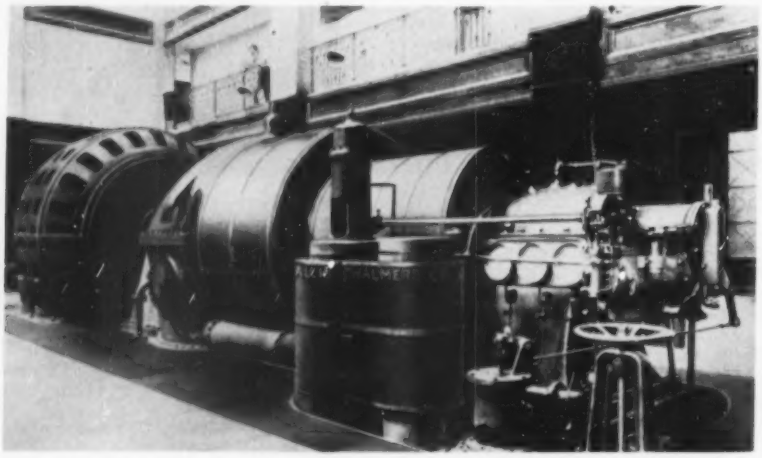
Wrought iron conduit set in piers connects with submerged cable in this new lift bridge over the Hackensack River



Still the champ, at least for the time being, this 208,000-kw GE turbine generator has operated since 1929 in the State Line station of Commonwealth Edison, Chicago. It will remain largest in the U. S. until the two 260,000-kw's go into operation for Detroit Edison Co. Operator in circle shows size of units

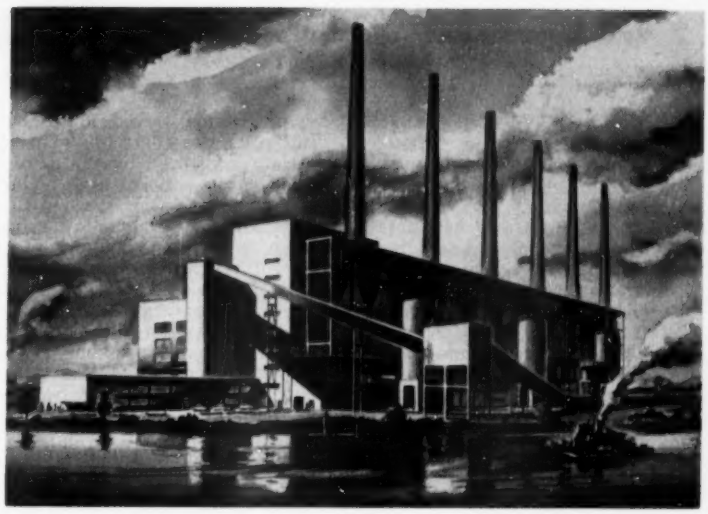
Old timers, dating back to Allis-Chalmers' entry into the turbine manufacturing field 50 years ago, are this horizontal Francis runner hydraulic turbine (right) rated at 1250 hp, and this 5500-kw steam turbine (below). Hydraulic unit was installed for the old Rochester (N. Y.) Railway & Light Company and saw steady service until May 14, 1952. It is still in operating condition. Steam unit was installed in 1905 for the Brooklyn Transit Development Co.





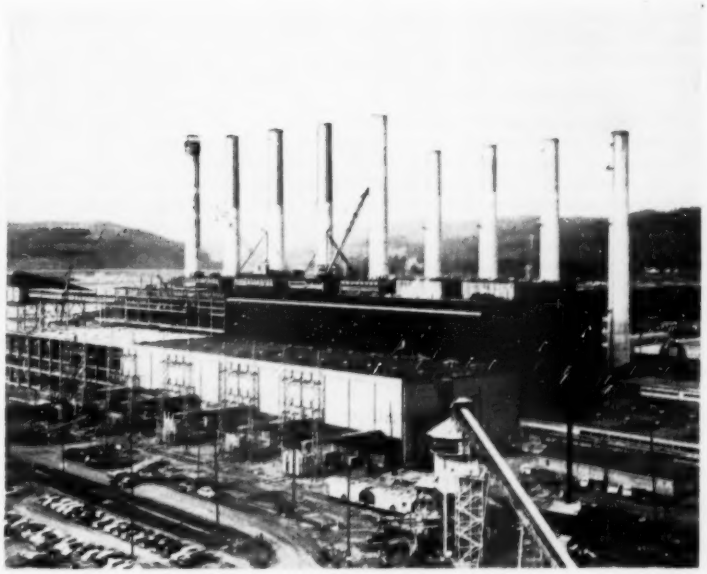
Wolverine Electric Cooperative's Johnson Plant at Hersey, Michigan, copped the tag "nation's most efficient REA internal combustion generating station" for the second straight year. It has three Cooper-Bessemer and three Fairbanks-Morse dual fuel engines. Its '53 record was 9348 Btu per kwh; its '52 record was 9815 Btu per kwh

Artist's conception of ultimate appearance of the new River Rouge plant of Detroit Edison. The first of two units rated at 260,000 kw each will go on line in 1956. GE and Westinghouse will make the first two units; B&W and CE will supply the 1,700,000 lb boilers. Plans for four additional units are in preparation. Coal will be fuel. Steam is 2000 psig, 1050 F; 1000 F in reheat



Gulp! This 16-ton Caterpillar diesel-electric set disappears into the hold of giant MATS C124 Globemaster at Chanute Field for transport to Greenland

First turbine unit of the world's largest power plant recently went through a test run at Kingston, Tennessee. Present authorized capacity of the plant is 1,440,000 kw, but it will ultimately develop 1,600,000 kw. Four of the plant's nine units will be rated 115,000 kw; the remaining five will generate 200,000 kw each. Cost of the new plant will be about $213 million, and it will require 450 million tons of coal per year and 1 million gpm cooling water. High pressure steam is at 2000 psi; turbines are 3600 rpm units. Most of its power will go to the AEC's big U 235 gaseous diffusion plant, located a few miles north, when it is started up

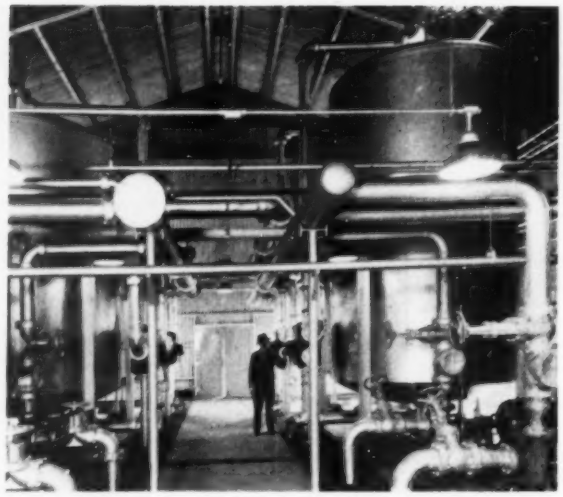


Which Will It Be .....

Demineralization or Evaporation?

Evaporators are being by-passed more often these days in favor of demineralizers as requirements for feedwater make-up become more exacting. The best one for your plant, however, must be determined by close analysis

By S. B. APPLEBAUM * and M. C. McKEOWN †



View of automatic demineralizer system with silica removal serving oil refinery

DEMINERALIZATION versus evaporation is a timely subject because public utility companies are still expanding to keep in step with increased demand. The choice between evaporators and demineralizers is being actively studied in the many expansion programs now under consideration. One of the earliest demineralizer installations was made at the Central Iowa Power Cooperative, Prairie Creek Station, Cedar Rapids, Iowa early in 1950 and has been in satisfactory operation since then. Evaporators had been purchased but were never used. Another pioneer installation in 1950 was made at the Public Service Company of Northern Illinois at Waukegan where a demineralizer replaced evaporators. The Wisconsin Electric Company is now installing Demineralizers in their Oak Creek Station and Port Washington Station. Commonwealth Edison Company has adopted demineralization for some of their stations including their new State Line Station at Hammond, Indiana. There are many other similar cases.

Changing Trend

Selection of evaporators was unchallenged until about four or five years ago and many new power plants are still favoring evaporators in their expansion programs. However, the trend is definitely toward demineralization as evidenced by the many discussions presented at technical society meetings in the last few years.

Increasing boiler pressure to over 1000 psig, and more recently to over 2000 psig, has raised the required quality standards of the feedwater. The main impurity receiving critical attention is silica. This causes trouble not so much in the boiler as in the turbines.

The only known solution of this problem is to reduce the silica in the steam to lower and lower figures. But since the silica in the steam is mainly influenced by the amount of silica in the concentrated boiler water, this latter silica must in turn be reduced to lower and lower figures. Then to keep the amount of boiler blowoff at a reasonable figure the silica in the feed water must be reduced to lower figures. Table I gives the limits of silica in the boiler water at various boiler pressures suggested by the Babcock & Wilcox Company engineers, at an A.S.M.E. meeting in 1951. Table II gives the silica tolerances in the make-up calculated from Table I for a boiler blowdown of 5 to 10% of the make-up. However, the figures of 3 to 5 ppm of silica shown in Table I for boiler pressures above 1000 psig are not accepted by many public utility engineers. Cases have come to our attention wherein engineers require silica in the boiler saline as low as 1 ppm. Therefore, in many demineralizer specifications recently issued, the silica in the treated water requested is as low as 0.01 to 0.05 ppm.

Total dissolved solids concentration is less important, but similar demineralizer specifications have called for values of 0.5 to 2.0 ppm. The feedwater, of course, must also be non-corrosive which is accomplished by proper deaeration and by maintaining a high enough pH value to prevent corrosion of feed lines, economizers, etc.

Those who still favor evaporators claim these general advantages:

Advantages of Evaporators

(1) Less skill is required for their operation than for demineralizers.
(2) They are less likely to get out of order.
(3) Economic studies have shown greater economy in some cases.
(4) The history of demineralization is too recent. Evaporators have been operated for longer periods and their selection is more conservative.

Those who have had experience with evaporators and who have adopted demineralizers in their place have disclosed certain operating problems with evaporators, which contradict the advantages claimed. These problems may be summarized:

(1) The evaporator coils get scaled up. In some designs of evaporators cracking off of the scale by thermal change is still favored. This is done to avoid pretreatment of the water ahead of the evaporator. However, such thermal descaling is not always successful. Only hard brittle scale can be thus cracked off. Softer scales do not respond to this cracking satisfactorily and acid treatments and other cleaning methods must be used. Therefore, the more conservative public utility engineers favor pretreatment of the water to keep the evaporators clean and free from scale and to do away with the damage to the coils which thermal cracking and acid cleaning may cause. Clean

Table I. Silica limits of feedwater versus pressure

Operating Boiler Pressure psig	Maximum Silica in ppm in Boiler Salines
600–800	25
801–1000	15
1001–1500	5
Above 1500	3

Table II. Silica limits of make-up necessary to maintain a blowdown at 5 to 10 per cent of make-up

Operating boiler Pressure Psig	Maximum silica in ppm in make-up to keep boiler blowdown at 5 to 10 percent of the make-up
600–800	1.25–2.5
801–1000	0.75–1.5
1001–1500	0.25–0.5
Above 1500	0.15–0.3

Condensed from complete paper before Wisconsin Utilities Association. For reprint of it, write the Editor. Use postcard elsewhere in issue if you wish.

Table III. Results of five economic studies in which evaporators were compared with demineralizers to determine which offered the lowest water treatment costs

Raw Water	PPM Total Dissolved Solids	Per Cent Alkalinity	Fuel Cost Cents Per Million Btu	Costs—Cents per 1000 gallons	
				Evaporation	Demineralization
I—Ohio River	300	19	20	92	93
II—New England Well	100	48	39	284	81
III—Delaware Well	50	12	—	181	44
IV—Iowa Well	150	50	21	187	92
V—Lake Michigan	156	80	—	46	12

evaporator coils result in greater efficiency and avoid shutdown.

(2) The quality of the distilled water produced by evaporators is not always satisfactory. The Public Service Company of Northern Illinois at Waukegan experience proves this. The total solids in their distilled water ran from 2 to 6 ppm for some of the evaporators and from others ranged from 4 to 10 ppm. This is not low enough. An evaporator is, after all, a boiler and the vapor quality produced is affected by the same factors that affect steam quality from boilers, such as:

(a) Quality of feedwater to the evaporator.
(b) Steam disengaging velocity.
(c) Control of water level.
(d) Concentration of solids in the evaporator saline which is controlled by evaporator blowoff.

Consequently, conservative engineers who select evaporators have been specifying larger and larger evaporator shell sizes to reduce steam disengaging velocity.

(3) The evaporator vapor may contain excessive amounts of carbon dioxide gas which will cause corrosion in the feedwater system. The demineralized effluent is free from CO_2 gas.

(4) The evaporator output varies with turbine load and rated output is not maintained at low turbine loads. The demineralizer is independent of turbine load and can, therefore, produce the desired output at all times.

(5) The evaporator at the time of its selection is tied down to a definite heat balance for maximum thermal efficiency. However, heat balances have a habit of changing with time as, for example, when a central station tries to sell extraction steam to one of its customers. When this occurs the old heat balance goes out of balance. The evaporator acts as a drag on such changes whereas the demineralizer favors flexibility of change for over-all station efficiency improvement.

(6) When a boiler is to be filled after a shutdown there is frequently no distilled water available unless very large storage tanks are used. The demineralizer, being a cold process treatment, does not require any steam and, therefore, provides proper feedwater at all times even for filling boilers. The Duquesne Light Co. have installed a demineralizer in one of their stations which is used for such filling purposes even though they have evaporators. After the evaporators are started up, the demineralizer is then used to scrub impurities from the feedwater by passing a small part of the total feed stream continually through it.

(7) The cost of operating evaporators must include the power lost by degradation of the pressure of the steam used in the evaporators.

Table IV. Rough guide for the selection of the most economical method of feedwater make-up treatment

Fuel Cost Cents per 1,000,000 Btu	Raw Water Dissolved Solids in ppm	Raw Water Ratio Alkalinity to Total Dissolved Solids	Economical Method
25 to 30 or higher	under 300 to 500	over 30% to 40%	Demineralizers
20 to 25 or lower	over 300 to 500	under 20% to 30%	Evaporators

Economic Comparisons

A number of economic studies comparing evaporators with demineralizers have been published. Table III summarizes the results of five of these studies as applied to plants located in the North East and Midwest sections of the country. The main considerations in making such a study are:

(1) Cost of heat in cents per thousand Btu's.
(2) Analysis and character of the water supply available. The higher the total solids and the lower the percent alkalinity, the higher the demineralizer operating cost.
(3) Initial investment including labor of installation, building, etc.
(4) Maintenance costs.
(5) Operating labor costs.
(6) Costs of chemicals for the pretreatment of water ahead of evaporators as well as for the treatment of water by the demineralizer.
(7) Replacement cost of ion exchange material.
(8) Power loss due to steam pressure degradation for the steam used in the evaporator.

Study I, Table III, is based upon the use of coagulated and filtered Ohio River water containing about 300 ppm of dissolved solids. The fuel cost is comparatively low at 20 cents per million Btu. With 1.5 per cent make-up requirement, the total annual cost for demineralization per 1000 gallons produced is 1 cent greater than for evaporation. These values were derived from annual fixed and operating charges of $89,300 against the evaporator and $89,800 against the demineralizer with an annual make-up production of 812 million pounds.

Study II, Table III, selected a New England well water containing about 100 ppm of total dissolved solids. The plant was designed to produce 42,000 lb per hour of treated water with a heat rate of approximately 10,000 Btu's per net kw hr. The annual charges in this case were $40,800 for the evaporator system and $17,400 for the demineralizer.

Results reported in Study III, Table III, by a chemical plant in the state of Delaware used a well water supply with 50 ppm total dissolved solids and compared the costs from existing single effect distillation equipment with an existing compression distillation unit and with an existing two-bed demineralization system. The results shown in Table III compare the single effect evaporator with the demineralizer. The cost for the compression still is $1.48 per thousand gallons which value is lower than the single effect evaporation cost but still far above cost of demineralization.

Study IV, Table III, used a well supply with over 500 ppm of total dissolved solids requiring pretreatment by cold lime softening which reduced these solids to about 150 ppm. This system producing 5610 lb per hour make-up shows a total annual cost of $6150 for the evaporator, $3002 for the two-bed demineralizer.

The Lake Michigan supply as utilized in Study V, Table III, was reported 156 ppm total dissolved solids with the annual cost of $23,000 for the evaporator and $6000 for the demineralizer.

Factors in demineralizer system design will be discussed by the authors in a subsequent issue.

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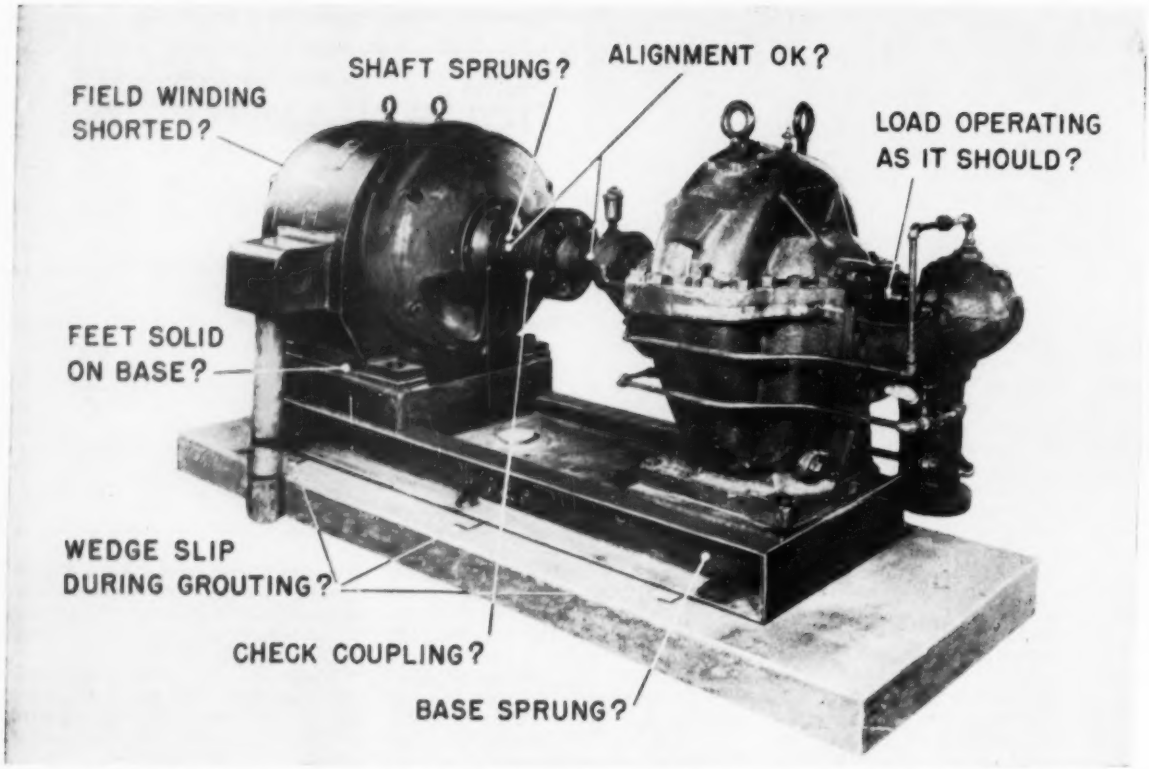


Fig. 1. A motor, perfectly balanced when it leaves the factory, may vibrate excessively when installed. Here are some of the points you should check if it does

Check ALL These Points to Stop MOTOR VIBRATION

Electric motors are precision balanced by the manufacturer to minimize vibration. However, in a new installation, vibration may still be noticeable unless all elements have been properly balanced

By J. H. JONES *

WHETHER YOUR driving motors have been in service for some time or they are brand new, they can and should be free of vibration. If vibration does exist, it may be due to any of several factors, including poor coupling, loose or uneven mounting, misalignment, partially short-circuited field on an old synchronous motor, or unbalance in the motor itself.

In almost every case the trouble can be located and corrected fairly easily. Logically, the trouble should be isolated by making a few simple checks to determine whether the vibration is originating in the alignment, coupling, load or motor. The following suggestions should help in correcting the trouble.

First, measure the vibration: Using a good vibrometer, measure the vibration at various critical points. Readings are usually taken at the sides of the bearings at about shaft height and on both sides of the frame of the motor or load being checked. A record of the initial vibration is important while the various tests are being made.

Disconnect or remove the coupling and run the motor alone: If the vibration is originating at the motor and not in the external load or coupling, running the motor with the load removed will disclose it. On the other hand, if the vibration disappears when coupling is removed, trouble is not originating in the motor.

Look for vibration in the motor feet: If the motor feet have not been properly shimmed, the motor is deprived of its intended supports. To check this condition, loosen all of the hold-down bolts in the motor feet and feel for vibration of the motor foot relative to the base. Tightening the motor feet to the base will only distort the motor frame and generate more vibration and also tend to cause misalignment. The feet should be properly shimmed to evenly distribute the weight and rest firmly on the base before the hold-down bolts are tightened. The shims should give the motor solid support directly under the end plates of the motor frame, not just under the extreme edges of the feet.

Inspect your grouting: On new installations, it is possible that a wedge slipped during the grouting. If a wedge between the base and the foundation moves after the base alignment is set, there may be a void between the base and the grout, resulting in vibration.

* Manager, Service Department, Electric Machinery Mfg. Co., Minneapolis, Minnesota.

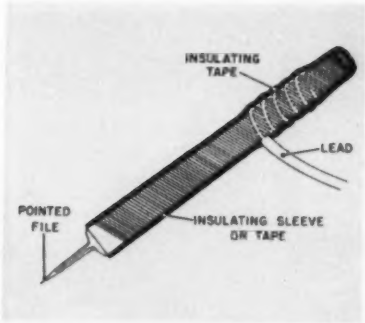


Fig. 2. Simple home-made field winding test prod

Fig. 3. Vibrometer checking on a grindstone drive

Check the base itself: The base may be subjected to considerable stress and strain before it is put on the foundation, and may not be necessarily true even after it has been pulled into shape with the foundation bolts during installation.

Although the motor may be vibration-free when run alone, vibration caused by poor grouting or questionable base installation will show up more quickly when the motor is coupled to its load, especially if the load requires high starting torques and is pulsating.

Check the possibility that the shaft is sprung: Motor shafts are usually designed for rough handling and heavy service, but excessive abuse may cause it to be out of line. In spite of the strong construction, the shaft and the rest of the motor should be handled as carefully as possible.

Check operation with the motor coupled to the load: Obviously, vibration is more apt to be evident while the motor is under load. Additional stresses from the torque transmission, alignment, coupling and characteristics of the load itself all are possible sources of trouble.

Review alignment: A careful check of the alignment between the motor and its load is necessary to make sure that the shafts are level and aligned perfectly, not at an angle. Motor air-gap measurements should be taken at several points around the rotor and should show uniform readings.

Inspect the coupling: The coupling should be of the proper size and in good operating condition. Slight trouble may develop if the key is much longer than the keyway coupling.

Take vibration readings on the load: Unbalanced operation of compressors, worn spur gear drives, hammermills, and similar loads may be responsible for the vibration.

Synchronous Motors

If vibration is evident while a synchronous motor is coming up to speed and synchronizing, as well as after synchronization, it is probably due to mechanical unbalance or misalignment. If the vibration shows up after synchronizing, however, and the motor has been in service for many years, the trouble may be caused by a partially short-circuited field winding. A check of the field winding can be made fairly easily by using a make-shift prod and following examples given in the next paragraphs.

Using the d-c drop method: A partially shorted field winding may be detected in several ways. The resistance of the individual field pole windings may be measured with an ohmmeter; or, with something less than rated excitation voltage across the collector rings, the voltage drop across each of the poles may be measured with a voltmeter.

The resistance of each pole will be around one ohm or less, so the ohmmeter used should have a low reading scale (of the order of a few ohms) to get accurate results. Any field winding whose resistance is considerably less than that of the others is probably partially short-circuited.

A second d-c method may be used. Put about half of the rated voltage across the rings to keep the temperature of the field windings down during the testing and measure the voltage across each pole. The voltage measured across each of the poles should equal the applied d-c voltage divided by the number of poles. If the reading on any pole is considerably less, that pole is probably shorted.

A-C drop method: The a-c drop method will give more positive results than the d-c method. The poles are tested by putting 120 volts a-c across each of the windings and measuring the current. The current will range from 10 to as much as 100 amp, depending on the size of the motor, but on partially shorted windings the current will be considerably higher than the readings taken on the other poles. The leads to the prods should be about No. 12 wire. Use about a 60 amp fuse in your a-c leads as a safety measure if you have not made a d-c check first. *Be sure* to have the a-c across the field windings for no longer than absolutely necessary to avoid overheating windings.

The current in each pole may be measured either with a current transformer and an a-c ammeter or a handy clamp-on ammeter. The metering equipment must be kept out of the magnetic field set up by the field windings. A distance of 4 or 5 ft from the windings will protect the meters.

The a-c amp readings on partially shorted poles may be affected considerably by the position of the rotor in the stator. Rotate the rotor the width of one stator slot tooth and make a second set of readings after you have taken the first one, then consider the average of the two readings per pole as accurate.

Poles at a small air-gap will give lower readings than poles at larger air gaps, so if there is any question about the readings, turn the rotor half a revolution and re-check.

Phenolic Foam

HERE'S a new type of thermal insulation which should have many applications, particularly in spaces that are awkwardly shaped or hard to reach. It's made by foaming a liquid resin up to 150 times its original volume, when it immediately

View showing amazing lightness of this insulation

solidifies as a light, rigid material. It combines excellent insulating properties with extremely light weight. Its insulating value compares favorably with other insulating materials, and its extreme lightness is shown in Fig. 1, above. It is also an excellent sound insulator.

During expansion, phenolic foam tends to assume the contours of the container or mold in which it is being made. This property enables it to be made in intricate shapes as well as in standard block form. Volumes as large as 50 cu ft have been filled by simply introducing the activated liquid resin and allowing it to expand. Densities can be controlled over a very wide range, from ½ to 20 lbs per cu ft, although the density of most "foam-in-place" foam will average 3–5 lb per cu ft.

If you want more information about this new product, just write PHENOLIC FOAM on one of the prepaid post cards elsewhere in this issue and mail it to us

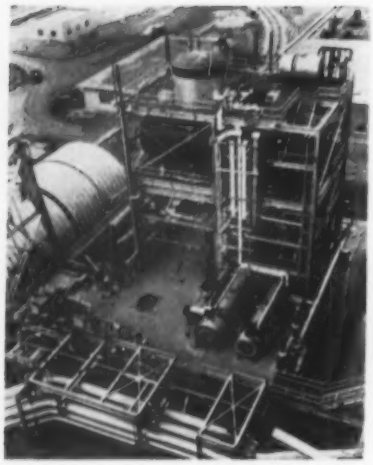


Fig. 1. Nearly-completed deaerator tower for an 80,000-kw generating unit at the Sandow Plant

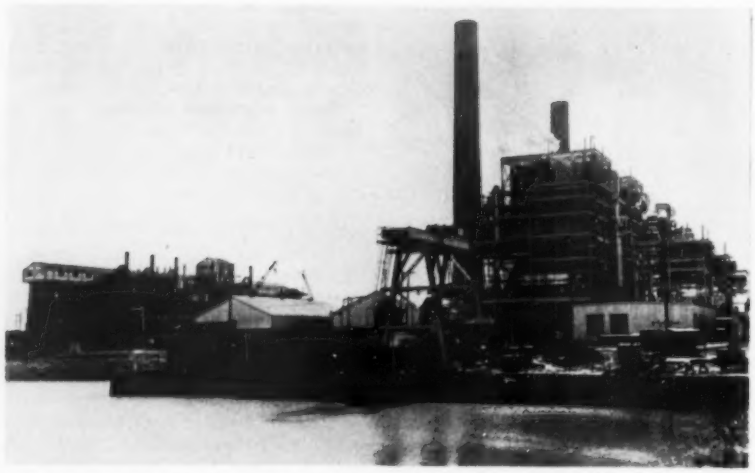


Fig. 2. General view of Sandow Power Plant and lignite-processing facilities, looking over lake intake structure. Plant is entirely outdoors. Three 80,000-kw steam turbine generators on open deck to right

Fig. 3. Aluminum canopy, rolling on rails, covers generating unit during erection, maintenance

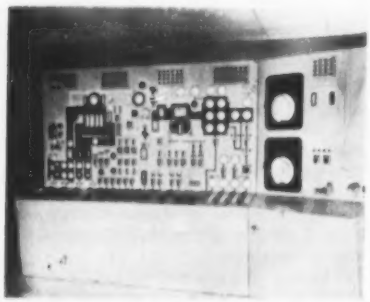


Fig. 4. Boiler and turbine generator control board in central control room, Sandow Power Plant, for one of the 80,000-kw generating units

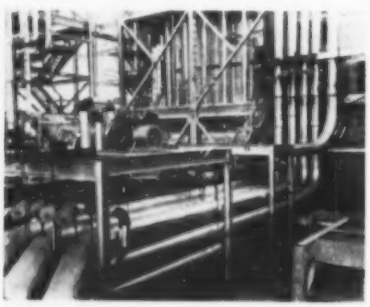


Fig. 5. Steam lines between boiler and turbine at Sandow Plant. Cross-over heaters, left center

Lignite Fuels 240,000-kw Alcoa Plant at Rockdale

NEW FOUR-POTLINE aluminum plant of Aluminum Co. of America at Rockdale, Tex., shown in Fig. 6, was formally dedicated on April 24, 1954. Rockdale Works can produce 90,000 tons of aluminum a year. It uses electric power generated in Sandow Power Plant, Fig. 2, where lignite fuel is burned under the boilers. This is the first aluminum smelting plant to use lignite as a fuel.

Sandow Power Plant is owned by Alcoa but is operated by Industrial Generating Co., an affiliate of Texas Power & Light Co., on Alcoa's behalf. For some time, TP&L had been investigating the feasibility of using processed lignite as a fuel for large-scale generation of electricity and had sponsored investigation in lignite fuel technology in co-operation with U. S. Bureau of Mines at Denver, Colo.

It requires about 10 kwh of electricity to smelt 1 lb of aluminum. Most aluminum plants have used large quantities of hydroelectric power or have burned natural gas for power generation. But present private sources of low-cost hydro power are limited and low-cost natural gas also presents problems. Accordingly, since large deposits of lignite were located near Rockdale, and the new technology of using it looked very promising, and since TP&L could supply enough power for operating a portion of the aluminum smelter while the power and lignite processing plants were being completed, it was decided to locate the new plant close to the lignite deposits.

The Sandow Power Plant, accordingly, was designed to consist of three condensing steam turbine generators, each of 80,000 kw capacity, each unit supplied with steam at 1550 psig, 1000 F, by a single 800,000-lb-per-hr steam generating unit. The plant is designed on the unit system and is entirely outdoors. Responsible for the design and construction was TP&L, and the contract for these was awarded to Ebasco Services, Inc. Two of the units are now in operation; the third is scheduled for operation in mid-1954.

Initially, the power-generating facilities are being supplied with lignite that has been crushed and dried for use directly as fuel for the boilers. It is hoped that eventually it will be commercially possible to obtain valuable tars from the lignite before it is burned, by means of a low-temperature carbonization process developed at the United States Bureau of Mines laboratories, Denver, Colorado, by Dr. V. F. Parry. This process was described in detail by Dr. Parry in a paper entitled Low-Temperature Carbonization of Coal and Lignite for Industrial Uses, before AICE recently.

Pilot operations on this carbonization process are now being conducted at Rockdale. Chemical by-products would be recovered from the tars by distillation, and the remaining "char" would be used as fuel for power generation.

The Milam County lignite to be used in the Sandow Power Plant has low heating value, relatively high ash content, and high moisture con-

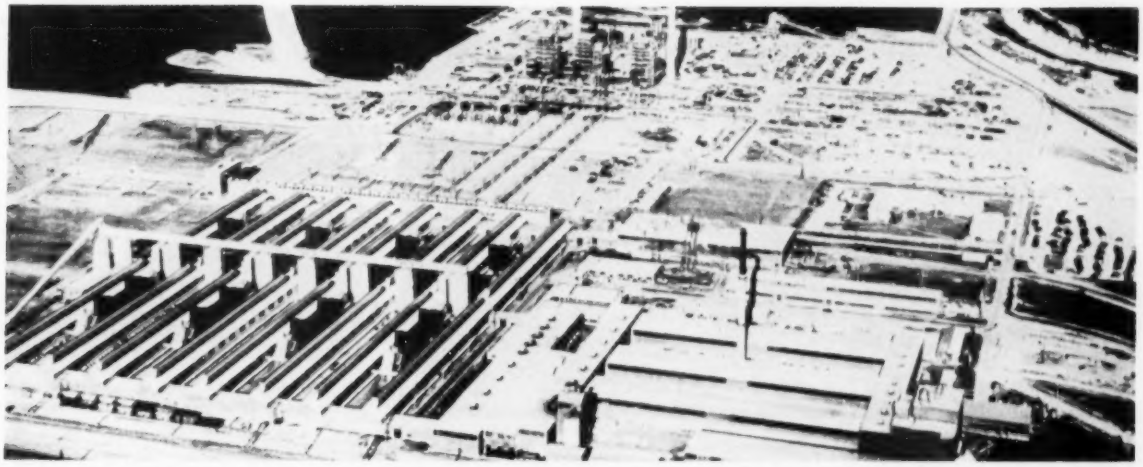


Fig. 6. Aerial view of Rockdale Works, Aluminum Company of America, near Rockdale, Tex., showing Sandow Power Plant at top and, behind it, created lake for cooling condenser circulating water. Power plant contains three 80,000-kw condensing turbine generators and three boilers, one per turbine

tent. This penalizes transportation of it, hence Rockdale Works has been built close to the lignite deposits. The fuel will be dried before use.

Four enormous dragline excavators, Fig. 9, remove overburden above lignite seams at Rockdale. Power shovels load it into a fleet of trucks, each of 62 cu yd capacity, which transport it to a conveyor belt system. The trucks have specially-built aluminum bodies, which resist acid corrosion by lignite.

The conveyor belt system that delivers the fuel to the plant site is nearly 3½ miles long, and designed to have maximum capacity of over 1,000 tons of lignite per hour. The system is one of the world's longest overland conveyors in operation today. The gallery structure carrying most of the system is made of structural aluminum shapes, and the tilting covers that shield the system are also of aluminum.

Lignite is deposited in nine storage silos by the conveyor belt system and is then carried to hammer-mill crushers, which reduce it to usable size — minus ¼ in. — for the drying process. The finely-crushed lignite is stored in continuous-pour silos until required. From these it is conveyed through

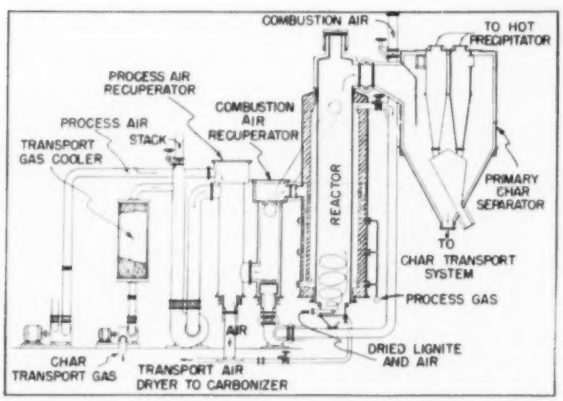


Fig. 7. (Left)—schematic diagram of carbonizer of Parry Lignite Process System being installed by Texas Power & Light Co. for Alcoa, to produce char for boiler fuel and by-products

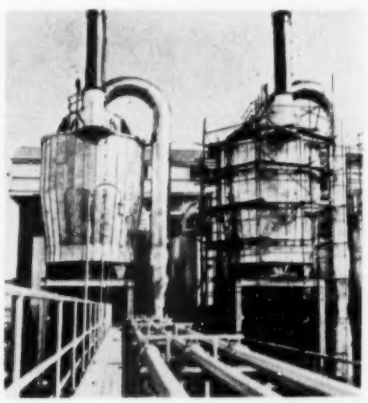


Fig. 8. (Right)—Here are first two lignite dryers put into operation at Sandow Plant

Fig. 9. Dragline excavator, stripping overburden from lignite deposits near Rockdale Works, is electrically-operated; 220-ft boom, 35-cu-yd bucket

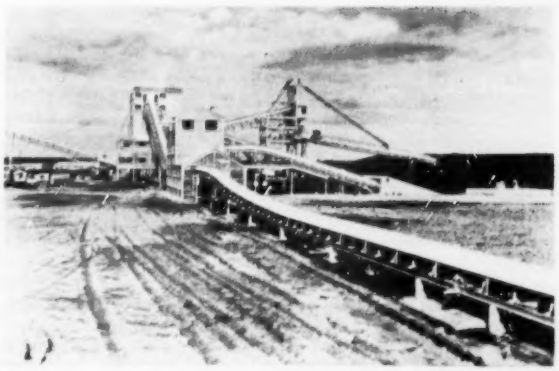


Fig. 10. More than 3 miles long, this rubber-belt, 8-flight conveyor system transports lignite to plant. Nearly all metal parts of conveyor are aluminum

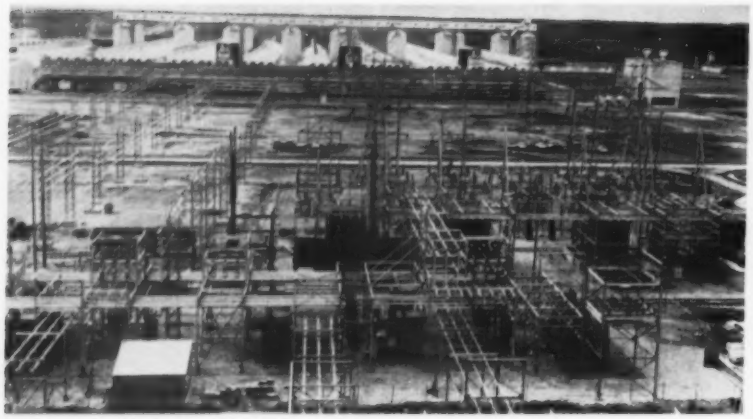


Fig. 11. Switchyard for 13.8-kv and 138-kv of Sandow Power Plant in foreground. Power at 13.8 kv is fed by circuits at left to rectifier station and potlines while 138-kv section at right connects to TP&L system

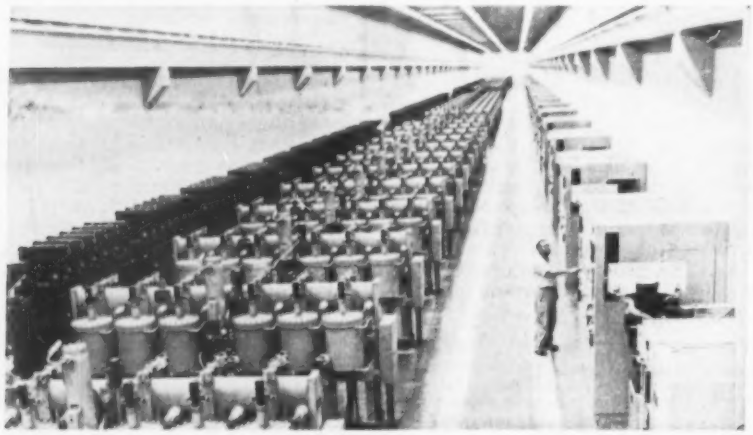


Fig. 12. Rectifier station where alternating current is converted to direct current for use in aluminum potlines

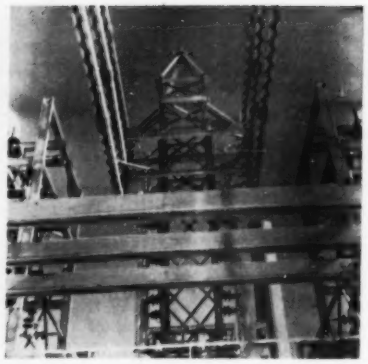


Fig. 13. Main 13.8-kv bus in foreground, with potline feeder bus shown above, in the switchyard

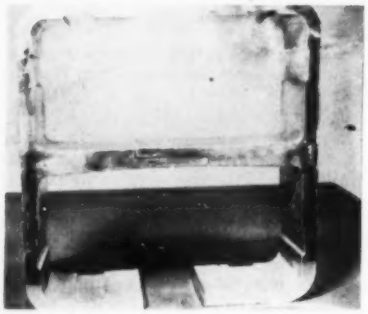


Fig. 14. Section of 12,000-amp extruded aluminum bus conductor used in the Sandow switchyard

the drying operations by a pneumatic transport system.

Process for drying lignite to be used at Rockdale was developed by the Bureau of Mines in cooperation with the TP&L and Alcoa.

Crushed raw lignite is moved from the storage silos by a pneumatic closed-loop conveyor system and brought to a hopper located above a screw feed in the drier. The drying process is summarized by its inventor, V. F. Parry, as follows:

"Products of combustion at about 1500 F. (produced by combustion of dried lignite dust with air and recirculated gases) enter the drier section at a pressure of about ¾ psig. The wet lignite is suspended in this drying column in a turbulent state. The fuel to the furnace is regulated automatically to produce a given temperature at the exit of the drying section. Normally this temperature is about 300 F. when the stack temperature is 275 F.

"About 94 per cent of the dried dust settles out in the primary separator, and the balance of the dust is separated in the secondary cyclone separator. The fine dust from the cyclones is returned to the furnace for combustion. The dried dust from the primary separator is moved with air to the boiler plant storage silo . . ."

A prototype carbonizer, together with its auxiliary equipment and an experimental tar-condensing system, has been erected at Rockdale and will be operated for several months to test the design and to produce tar for research market studies. Tars are recovered by a tar-condensing system. Considerable work remains to be done on the chemical composition of the tars, and little is known so far as to the nature of products which may be obtainable from them, or on markets and uses for them.

Steam-generating units are of the continuous slag-tap type, fired tangentially. Each unit is equipped with 12 fixed burners, and provisions have also been made for burning surplus process gas produced in carbonizing operations.

Each unit has aluminum drum end walk-in housings, and the walkways, platforms, stairs and handrails are also of aluminum.

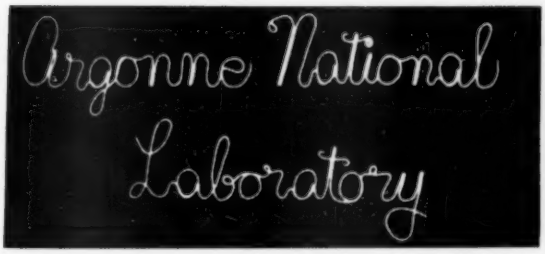
Two low-pressure U-tube feedwater heaters are used on each unit. An evaporator with a separate deaerating preheater, supplied with bleed steam, is used to supply boiler-water makeup. An outdoor deaerator, Fig. 1, is mounted on the boiler feed storage tank and is designed to pass 873,000 lb of feedwater per hour to the boiler feed pump. Condensate storage tanks are aluminum. Three 10-stage boiler feed pumps are installed for each steam unit. Evaporator feedwater is taken from the water supply furnished by the Rockdale smelting plant.

Unit cycle piping system for each steam generating unit is separate, having no interconnection with the systems of other units. But service water, cooling water, potable water, station air, compressed air and instrumentation are interconnected for the entire three-unit station. Station air, instrument air and vacuum cleaning piping systems are made of aluminum. Insulating material for outdoor piping systems is also covered with sheet aluminum.

Cooling water for the Sandow Power Plant is obtained from the 850-acre lake, artificially created near the plant site for the purpose. Water is pumped into the lake from Little River, about 12 miles away, through a 36-in. reinforced-concrete pipeline, by three 5-stage electrically-driven vertical turbine pumps.

The lake is divided by a dyke into two "ponds," connected by a canal 6,800 ft long. The smaller lake receives the condenser water discharge; the canal *continued on page 125*

Fig. 1. Rays emitted by Argonne's newly-developed thulium X-ray unit were used to produce this unique X-ray photograph. Pieces of wire solder were bent to form the words. This wire sign was then placed on top of a 3-inch thick Chicago telephone directory. The X-ray film was placed under the book. The X-ray unit was located 3 ft above the film when the exposure was made. A cable release operates the shutter



Argonne Develops Small X-Ray Unit

A SMALL, INEXPENSIVE, and portable X-ray unit which has potential uses in medicine and industry has been developed by scientists at Argonne National Laboratory of the Atomic Energy Commission.

The active component of the instrument is a tiny particle of thulium which has been made radioactive in the heavy water nuclear reactor at Argonne. Thulium is an extremely rare material, a rare earth metal of atomic number 69, which heretofore has found little practical application. The thulium is mounted in a source holder and shield equipped with a shutter mechanism in order that X-ray photographs may be made. The shutter is operated by a standard photographic cable release.

The Argonne development, which was directed by Samuel Untermyer, may meet the long-time need for simple, cheap, and portable equipment for making X-ray photographs. Although the entire unit weighs less than ten pounds, the radioactive thulium provides rays which are comparable in energy to a 100,000 volt X-ray machine. The instrument does not require an electrical power supply as does conventional X-ray equipment. In addition, it is quite inexpensive. Exclusive of irradiation charges, the total cost of the first model was $40.

The use of thulium as an X-ray source was first suggested by British scientists who have developed a similar but less powerful instrument. Excellent rare earth separation facilities and powerful reactors in this country permitted development of the Argonne instrument which contains a thulium source several hundred times more powerful than the British units. This greater power makes the Argonne unit potentially useful for medical and industrial purposes.

For diagnostic purposes equipment of this type will be of greatest value in isolated locations such as Army field hospitals, naval vessels, and isolated construction projects. Industrially, it has potential use as a density determination device. It may find considerable use in the determination of levels and densities of liquids in closed systems.

Argonne has also supplied very strong thulium sources, made radioactive in the Materials Testing Reactor at the National Reactor Testing Station in Idaho, to the Argonne Cancer Research Hospital, Chicago, and to the Army Medical Research Laboratory at Fort Knox, Ky., where they have been in use.

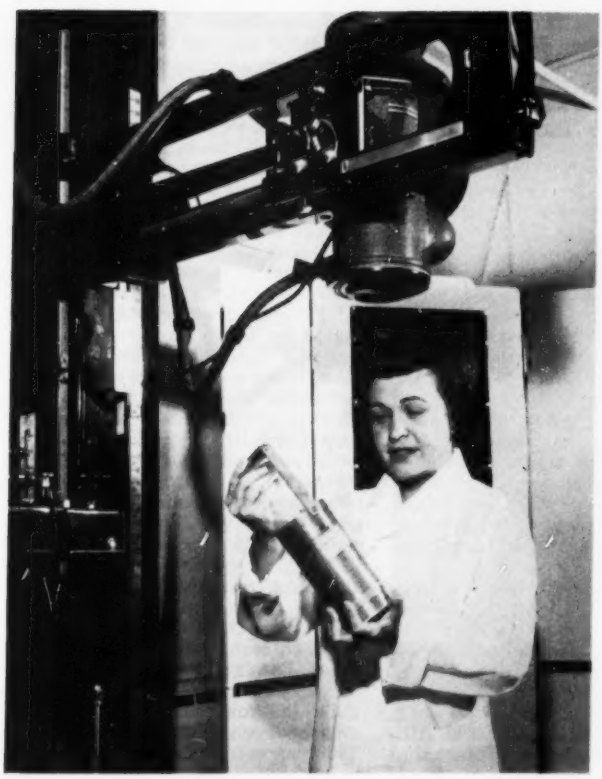


Fig. 2. (Above) Rays emitted by Argonne National Laboratory's newly-developed portable X-ray unit were used to produce this photograph

Fig. 3. (Left) The new and inexpensive portable X-ray unit which was developed by scientists at Argonne is held by Miss Eleanor Baran of the Laboratory's Health Division. Its portability and size may be compared to that of the standard X-ray machine shown in the picture

• Kitimat
• Kemano
• Kildala
• Kenney
Which Is Which?

As the first part of Kitimat nears completion, it is receiving much well-deserved publicity. Many readers, however, complain that while picking their way among the superlatives, they trip over these other K's without being sure where each one fits in. Here, to put an end to this confusion, is a simple explanation of the whole project

Fig. 1. Part of 50-mile power line that will run from Kemano to Kitimat plant

IN 1886, Charles Martin Hall, working at Oberlin College, Ohio, developed an electrolytic process for extracting aluminum from bauxite, or aluminum oxide. Aluminum metal had been obtained some years before by chemical process but in such small quantities that it was regarded as a rare metal, known only to a small group of scientists. The Hall process made it possible to produce the metal in sufficient quantities for industrial use, and the metal's remarkable properties soon caused the demand to outstrip the supply.

To produce enough aluminum to satisfy this growing demand, large amounts of electric power were needed. This dependence on cheap power dictated the choice of sites for aluminum production. To transmit so much power over long distances would have been prohibitively expensive, and as bauxite, a fine white powder, could be handled and transported easily, large-scale aluminum smelters were usually located close to hydro-electric power sites.

Why Kitimat?

Thus, in the United States, Niagara Falls became a center for aluminum reduction, and the metal was first produced in Canada at the beginning of the century at Shawinigan Falls, where low-cost hydro-electric power was available in large quantities. As the price of aluminum came down and new uses were found for it, the industry had to double its capacity every 10 years to keep up with the demand. What seemed like abundant power at Shawinigan became insufficient, and in 1926 production was started in the Saguenay Valley at what was later to become the giant Arvida plant.

Less than 25 years later, the power resources of the Saguenay were becoming inadequate and the industry had to find more sources of low-cost power.

That is the background leading to the decision of the Aluminum Company of Canada to build the Kitimat project; an undertaking which for sheer magnitude and grandeur of conception rivals any engineering achievement in the world today. The diagram in Fig. 2 has been prepared to explain this conception. It is not to scale nor does it show actual profiles, but it serves to illustrate the boldness and imagination of the overall plan.

Kitimat is about 500 miles from Vancouver; its approximate position is shown in Fig. 4. Figure 2 shows an East-to-West section through the area. Between A and B were a series of lakes, about 2700 ft above sea level, which drained at B through a deep gorge known as Grand Canyon, into the Nechako River.

The Nechako then flowed East to form one of the principal sources of the great Fraser River. Here, then, were the two main requisites for hydro power; a large quantity of water and a high head. Some hydro developments have small quantities of water at high heads; others have large quantities of water at low heads; here was the ideal — enormous quantities at very high head.

There were, however, a few details that had to be taken care of before this high level water could be transformed into electric power.

Though the lakes held a large quantity of water, mountain rainfall fluctuates, and a reservoir would be needed to absorb seasonal fluctuations in water level. Also, the nearest point that ships could reach, and the nearest piece of flat ground on which a smelter could be built, was at Kitimat. Another snag was the fact that the Nechako River flowed East, away from Kitimat and the sea. Admittedly it flowed into the Fraser, and the Fraser eventually flowed West into the Pacific, but as it reached the sea way down near the U. S.-Canadian border, and it certainly wasn't navigable up in the mountains, it wasn't much use as a means of transportation for ocean-going ships.

Largest Dam in the World

Figure 2 shows how these problems are being solved.

First of all the Nechako River, where it flows through Grand Canyon, was blocked by Kenney Dam, the largest rock-filled dam in the world. Then its flow was reversed by drilling two tunnels for 10 miles through the rock of the coastal range at Kemano. Through these tunnels the water drops 2500 ft to the turbines in the powerhouse, from where it discharges through the tailrace tunnels into the Kemano River, and so to the sea.

Having been generated, the power has to be taken to the aluminum-reducing units, and nearest place where there is a flat site for building, and access from the sea is at Kitimat, which is at the tip of one of the long deep fiords that form part of this section of the rugged British Columbia coastline. Kitimat is about 50 miles from Kemano, and the only way the power transmission line could be taken was over the pass of Kildala, a mile high obstacle, snow and blizzard bound for half the year and no easy journey the other half.

Kenney Dam was named after the then Hon. E. T. Kenney, Minister of Lands and Forests. It blocks the path of the Nechako River to the East and makes a reservoir of the area between Kenney and Kemano. The reservoir, which will take nearly

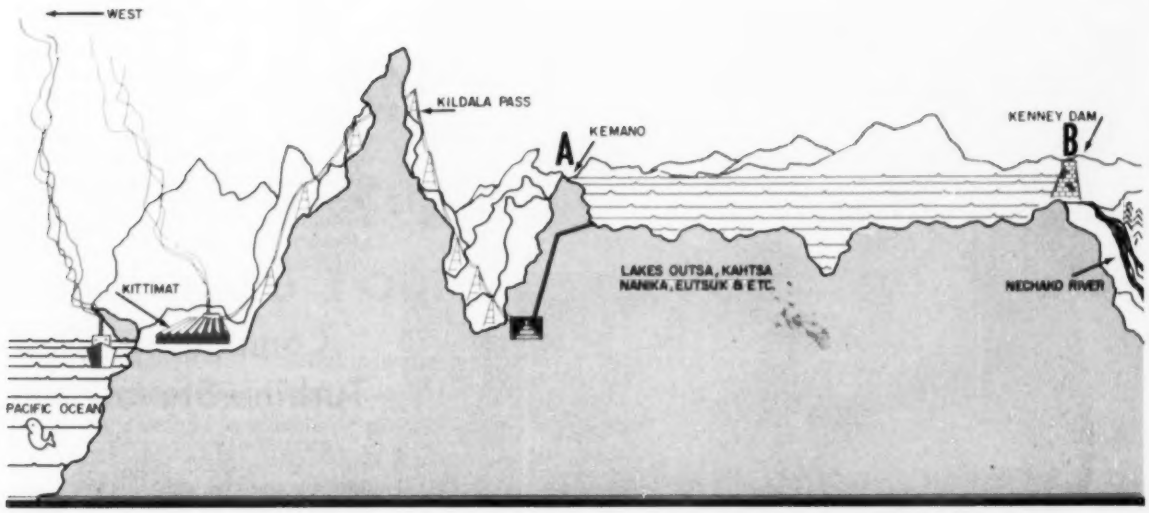


Fig. 2. Simplified diagram to illustrate the main points of Alcan's B.C. Project. Kenney Dam at B blocks Nechako River flowing East, forms an enormous reservoir and makes the river run West at A through turbines at Kemano. From Kemano powerhouse the power goes over Kildala Pass to Kitimat aluminum smelters

five years to fill completely, will be 150 miles long, and will cover an area almost as large as the state of Connecticut.

At the Kemano end of the reservoir, two 25-ft power tunnels will run 10 miles through the rock to give a vertical drop to the turbines of 2500 ft, about 16 times the height of Niagara. The powerhouse, which has been blasted out of solid rock, will eventually have 16 vertical single-runner impulse turbines, each rated 140,000 hp with an expected output of 150,000 hp.

The vertical 3 phase, 60 cycle 327 rpm, 13,800 volt, generators will be rated at 106,000 kva at 60F or 122,000 kva at 80F.

The transformers, also housed in the underground cavern, consist of double-primary banks of three single-phase type units, each with a nominal rating of 71,000 kva or 213,000 kva per bank. They are forced oil cooled, the water being cooled in two separate heat exchangers.

Transmission Problems

Transformer output is transmitted to the 300 kv outdoor switching station through high-voltage power cables. Output of each step-up bank is carried by three paper insulated oil filled cables per circuit, with a current carrying capacity of at least 550 amps. The cable circuits are approximately 2000 ft long, with a maximum difference in elevation of 75 ft. They are of the Pirelli type, with oil in a central duct through the cable.

From the power plant, the first 10 miles of the transmission system will comprise two double-circuit tower lines. They will gradually climb to about 1000 ft, where they will feed into a switching station with motor-operated switches. From here the two single-circuit lines will run for

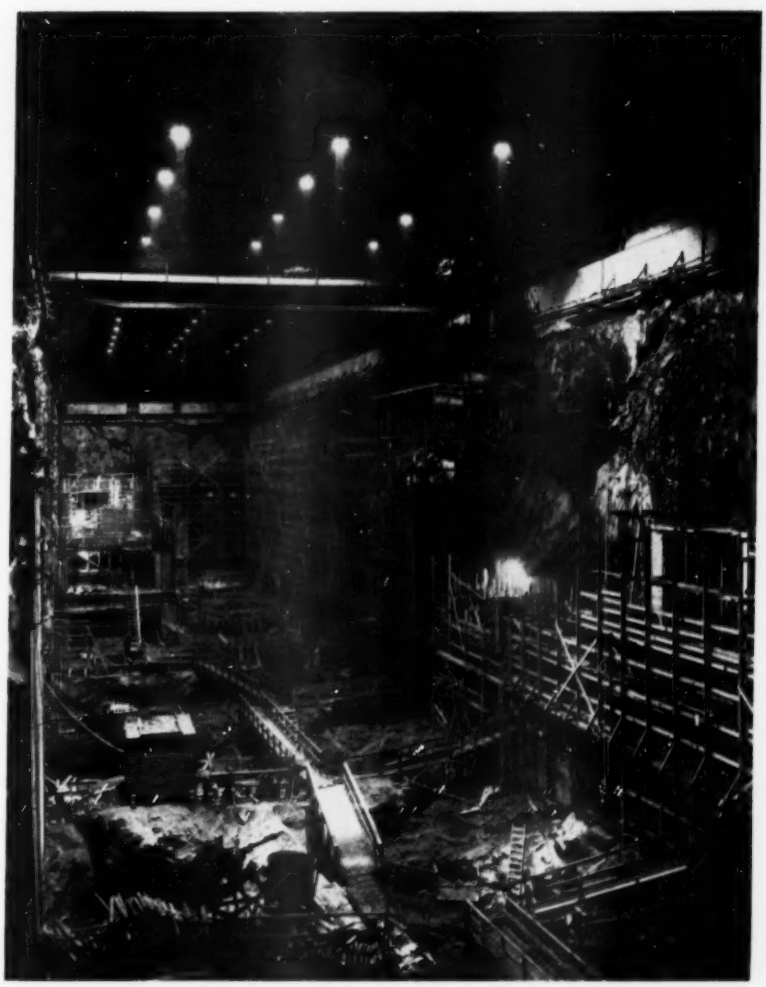


Fig. 3. Power house cavern blasted out of solid rock at Kemano, British Columbia. Chamber is 1000 ft long, 80 ft wide, and 135 ft high. Cavern is large enough for ultimate installed capacity of 2,240,000 hp

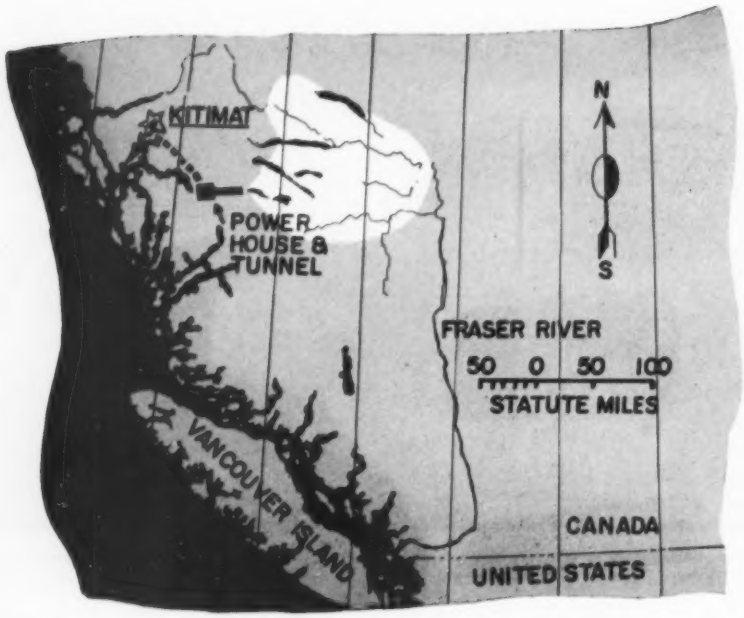


Fig. 4. Part of an aerial map showing location of Alcan's Kitimat, Kemano Project in British Columbia

about 10 miles through Kildala Pass up to a maximum altitude of about 5300 ft. For the remainder of the journey down to the terminal at Kitimat, the line will be double circuit.

Designing for the transmission of about 1,250,000 kw firm delivery power through this narrow valley was difficult. Icing, blizzards, snow and rock slides all added to the problem. This system will use some of the biggest steel cored aluminum conductors in the world, 2.3 in diam, and the line will have the world's highest system loading.

At the Kitimat terminus will be the largest aluminum reduction plant in the world, which will have an annual capacity of 500,000 tons.

Since the whole project is being built in uninhabited country, a city will be built for the people who will work the plant and for other industries that will probably be attracted to the area by the abundant cheap power. The city may have an eventual population of 50,000 in a few years.

In addition, a seaport is being built at Kitimat, to accommodate ocean-going ships that will bring the raw materials to the reduction plant, and then take away the finished product.

Most of Kitimat's bauxite will come from Jamaica, in the West Indies. Subsidiaries of Alcan have already built a new alumina plant near Mandeville in Jamaica, and others are building a fleet of 10,000-ton ships to carry the bauxite from Jamaica to Kitimat.

Fig. 5. Bucket wheel for a 150,000 hp turbine on its way to Canadian Allis-Chalmers for final assembly

Combination Gas-Turbine-Steam Plant

EXHAUST GASES from a gas turbine are being utilized in an ingenious way by the Gas and Electric Company of Algeria. The exhaust gases, which still contain 70 to 80 per cent of their normal oxygen supply, are conducted into the furnace of a steam boiler as combustion air. Since temperatures are between 356 and 752 F, this amounts to a high degree of air preheating and should raise the overall efficiency of the combined plant, according to *Swiss Technics*.

In the Algerian installation, engineered by the Oerlikon Engineering Company of Zurich, Switzerland, electric power and steam were both required. Steam is not used in turbines in this plant, the entire generation being accomplished by a 730-kw gas turbine generator. Specific performance details are not available at this time.

Editor's Note: Considering the high percentage of excess air required by gas turbines (hence the 70 to 80 per cent unused oxygen), it would seem that this cycle could be advantageously employed in combined gas- and steam-electric generating stations. This seems especially desirable where gas turbines are added to existing steam plants to bolster production for peak loads or where limitations in water supply do not permit expansion of plants with additional steam units.

From this point in speculation, it is only a short step to the question of feasibility of gas-turbine forced-draft blowers to serve steam boilers. In this case, little or no electrical power would be generated by the gas turbine, its entire output going into the blower or compressor supplying combustion air for the turbine and boiler. The same turbine could furnish emergency power during plant shutdowns and supply combustion air to the boiler even when it is necessary to start up independent of external power.

Where oil or gas fuels are employed in the boilers, complementary gas turbines can burn the same fuel. The Algerian installation mentioned here burns oil in both the turbine and the steam boiler.

Vacuum Can Collapse Your Tanks

Vessels designed for internal pressure may have little strength in the opposite direction and if a vacuum is produced accidentally, atmospheric pressure of 15 psi on the outside of the vessel may cause it to collapse, or implode. This danger is shown by the following examples of expensive pressure vessels ruined by unexpected vacuum

Photo: The Locomotive

Above: Remains of a copper evaporator whose dished head collapsed after reduction from ¼ to about 1/16 in. due to wearing action of contents. This type of accident, in which a tank designed for a certain pressure is eroded until the walls become too thin to prevent its collapse, is quite common

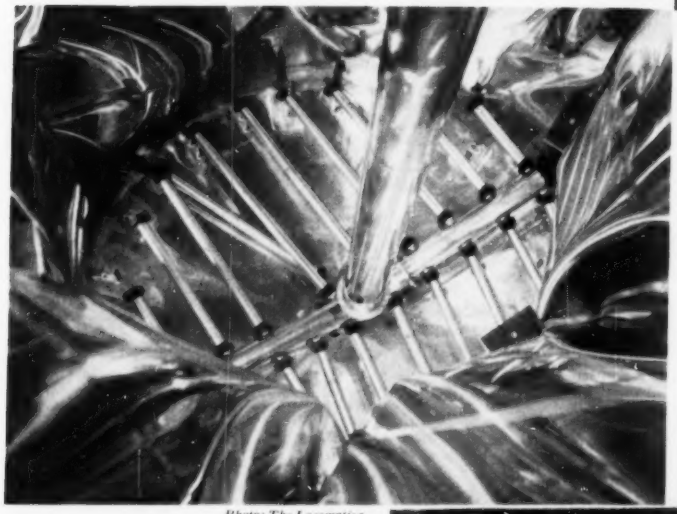
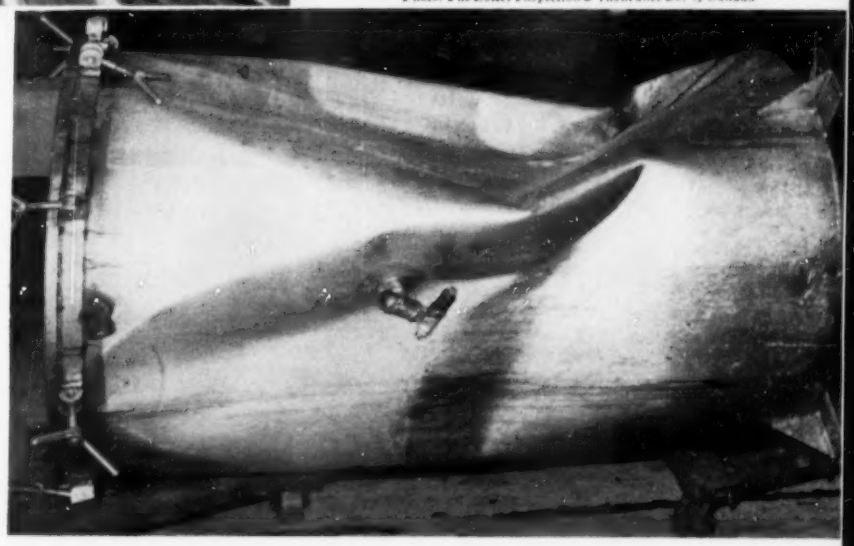


Photo: The Locomotive

Left: This is what happened to a stainless steel jacketed kettle when an unexpected vacuum was produced inside it. Jacketed vessels are more liable to damage than unjacketed ones since jacket steam pressure is added to the atmospheric pressure on the vessel tending to collapse it



Below: View inside expensive stainless steel vessel after it had collapsed. Though many vessels are fitted with vacuum breakers, many have collapsed because the breaker valve has not been big enough to let air in quickly enough to reduce the vacuum to safe limits before the vessel walls collapsed

Photo: The Boiler Inspection & Insurance Co. of Canada

IF YOU TAKE an ordinary rectangular gallon can, put half an inch of water in it, leave off the screw cap, and bring the water to the boil by putting the can on a gas burner for a few minutes, the steam will drive nearly all the air out of the can. Then, with the water boiling vigorously, if you suddenly screw on the cap and put the can under a stream of cold water, the steam will condense and atmospheric pressure acting on the outside of the can will crumple it up like so much paper.

The same thing happens on a larger scale in industry when an unexpected vacuum is produced in a vessel which is not designed for it, and though these implosions, as they are called, do not usually produce as spectacular effects as explosions, they often result in costly damage, as these photographs show.

In recent issues we explained some fundamentals of acoustics and described modern method of locating sources of excess noise. Now we describe practical methods of reducing this noise

How to Reduce Power Plant NOISE

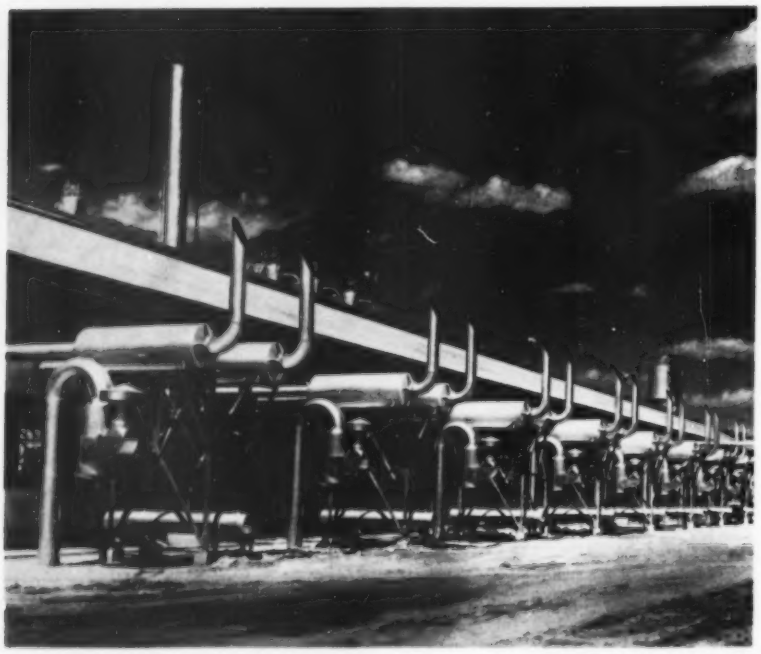


Fig. 1. Row of compressor intake snubbers make an impressive line at a recycling plant in Louisiana

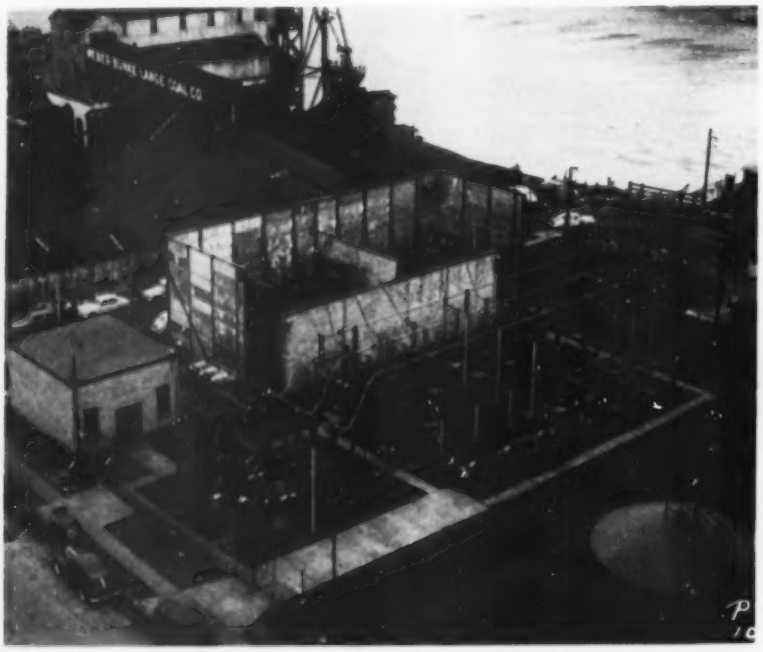


Fig. 2. Insulating walls being erected around transformers in city substation. Industrial area may change to a residential, and transformers once quiet enough may need extra quieting for new situation

By W. F. FRIEND*

IT IS DIFFICULT to give any standard procedure for reducing noise, since nearly every noise problem has peculiarities needing particular treatment. Although details vary, the principles of practical noise prevention can be applied generally, and to illustrate them we will give a number of examples showing how actual industrial and power-plant noise problems have been solved in practice.

These examples will be given under the following heading:

1. Outdoor generating stations
2. Pumps
3. Air compressors
4. Fans
5. Natural gas pipeline stations
6. Cooling towers
7. Transformers

In a subsequent issue we will discuss chimney noise reduction, the cost of remedying noise nuisances, and some recent court decisions on the subject of excessive noise.

Outdoor Stations

Experience with outdoor, or semi-outdoor, steam-electric generating stations shows that noise can be held at a level acceptable to neighbors without losing the economic and operating benefits of simple structures.

In one example, it is reported that in initial operation of an outdoor-type plant, there was at first some objectionable noise from forced-draft fans, exhaust stacks on boiler blow-down tanks, vents on deaerating heaters, and natural-gas flow through burner-supply headers and regulating valves

* Mechanical Engineer, Ebasco Services Incorporated.

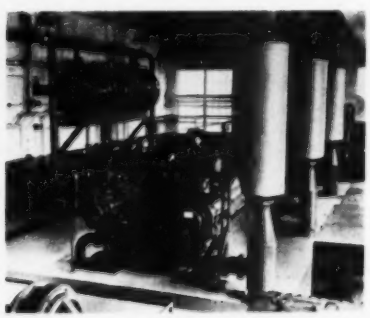


Fig. 3. Bank of large compressors with snubbers installed on intakes to reduce pulsation noise

at the boilers. Improvements were effected by enclosing the fan-suction openings, placing silencers on vent piping and an exhaust hood at top of the blow-down tank vent, equipping all safety valves with silencers, and insulating the high-velocity gas lines. In more recent plant designs, the breeching system together with induced-draft fans and soot collectors have been designed with special acoustical features.

Pumps

Control of noise from pumps is sometimes accomplished by inserting in the suction and discharge piping connections a short length of flexible-wall material, preferably rubber with embedded metal reinforcing, or a piece of corrugated thin-wall tubing of copper or its alloys. However, pumps operating at 3600 rpm may introduce water-column noise transmission as well as along the pipe itself, making the rubber coupling ineffective.

Frequency of the noise fundamental in pumps is the product of revolutions per second and number of impeller blades; harmonics may also be present. The water-column noise can sometimes be attenuated by pressure-release action of elastic-wall material, suitably protected from the stress produced by internal water pressure. High-pressure boiler feed pumps are difficult to silence, and if excessively noisy at certain delivery rates, must be enclosed in a suitably constructed room or in a removable housing arranged also to contain the piping connections. Thermal and acoustical insulations on pump casings are seldom effective. Figure 4 shows one method of reducing excessive noise from a pump motor's air cooling system discharge.

Air Compressors

The air intakes of compressors and of internal-combustion engines quite often are sources of objectionable noise: for small compressors, standardized snubbers built on good acoustical designs are obtainable from stock, but they must be selected to suit the cylinder size, strokes per minute, and size and arrangement of the intake line. With large machines, taking their air supply through lowered intake housings which contain air-cleaning filters, special "acoustic filters" are sometimes needed to reduce noise. These make use of large concrete "capacitance chambers" combined with choke tubes, for which the arrangement and calculated dimensions should be checked by tests on acoustical models before proceeding with construction. Figs. 1, 3 and 7 show examples of snubbers in practical use.

Fans

Draft fans in steam-electric stations are responsible for noise complaints from time to time. Forced-draft fans using inlet-vane method of regulation may show 110 to 115 decibels close to the inlets. Enclosures constructed around the inlets or surrounding the entire fan and motor have usually solved the difficulty. Such housings may be of sheet steel, designed to be easily removable for fan maintenance, arranged to give 180-deg turn for the air to constitute a sound trap, and provided with acoustical interior lining. Double-suction slow-speed fans are indicated where noise control appears necessary.

Induced-draft fans and dampering controls require special consideration. Recommendations submitted by fan manufacturers for low-noise level vary considerably; equipment designs and installation features to obtain quiet operation are still in a state of flux.

Previous methods for rating the noise characteristics of many kinds of fans and blowers, including those for ventilating and air-conditioning service, for cooling towers and even for wall and table use in offices and residences, are being re-examined today. Locations for microphone of the sound level meter, whether inside or outside the connecting ducts, the conditions for air or gas delivery, method of mounting fans during tests, and other factors, are still subject to disagreement. Caution must therefore be used in choosing fan type, in phrasing the terms of guarantees covering noise, and in general design of supports, duct connections and controls. Figs. 5 and 6 show typical examples of the way insulation must be placed to reduce fan noise.

Gas Pipeline Stations

A natural-gas pipeline compressor station, at which excessive noise occurred, had identifiable sources which included the air intakes for engines, exhaust pipes and mufflers, vibrating gas and hydraulic-auxiliary piping, and fans of dry-air type coolers. Intake and exhaust pulsations, both individually and in combination, created beat notes and fluctuating build-up of noise that depended upon phase relation and speed variations of the several engines, and on number of engines in operation. In addition to direct noise transmission, there were inaudible air-borne vibrations with frequencies around 20 cps which at residences in the neighborhood sometimes caused rattling of windows, panels, dishes and other objects responsive to such pulsations. Changes agreed upon included the following:

1. Air-inlet connections for internal combustion-type, compression-type compressor units were modified and acoustical snubbers were installed.
2. Location, height and direction of muffler outlet pipes were changed.
3. Acoustical insulation was applied to engine exhaust mufflers and piping.
4. Vibration in certain overhead pipes was eliminated.
5. Hydraulic-type pressure control system was altered to minimize

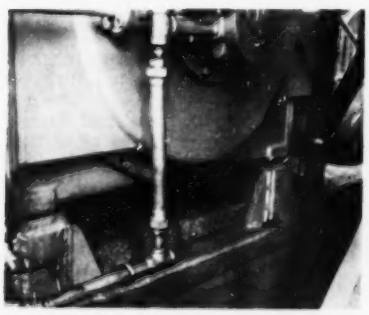


Fig. 4. Sound-absorbing material under this pump motor reduces noise from cooling air discharge

Fig. 5. Fan intake hood lined with sound absorbing material. Wall on right forms sound baffle

Fig. 6. Acoustically lined concrete block enclosure for forced draft fan. Note lining on door

...Power Plant Noise

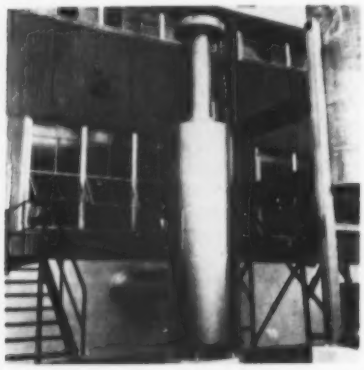


Fig. 7. Cleaner snubber on gas engine compressor

the vibration induced by the fluid.

6. Acoustical insulation was applied to interior of station building.

7. Trees, shrubbery and other landscaping features were added in the direction of residences.

For air inlet connections, the pulsation traps were specifically designed to be effective in the low-frequency range of air-borne vibrations. The fans of dry-air coolers, together with their hydraulic auxiliary power units and reduction gears, were also given attention.

At a regulator and meter station in a natural-gas pipeline system, there was present a shrill whistle or shriek, more irritating to the listener than common noises of greater intensity but of lower pitch. Investigation of regulators' designs showed no definite superiority for any type; noise was found to be caused by gas turbulence and generally to be of greater intensity in the piping several feet downstream than within the regulator itself. By covering the regulators and piping with sand to a depth of 4 to 6 in. and applying bitumastic black top to keep it in place, the objectionable noise was eliminated.

Cooling Towers

Cooling tower for supply of condensing water to the air-conditioning system of a utility-company office building brought noise complaints from a nearby hotel.

Conditions were corrected by the following measures:

1. A fan having lower tip speed, greater number of blades, and better blade control was substituted.

2. Steel support for motor and gear reduction unit was reinforced.

3. Acoustical labyrinth baffles were installed around the air-intake louver at base of tower.

4. Casing panels were stiffened and louver boards wedged, to prevent vibration and rattle.

These changes made it unnecessary to move the tower to another location where masonry enclosing walls could be built around the tower.

Transformers

Transformer noise level depends on size and voltage, and for sizes used in residential areas, permissible value is equivalent to about 40 decibels at a distance of 300 ft from the transformer. However, this level may still prove objectionable, since the noise has predominant frequency components at multiples of 120 cps which will be noticed above an ambient background level of 30 to 45 decibels. Still worse, it is found that whenever a noise spectrum contains only a few frequency components at high intensity levels, as in the case of transformers, the noise may become focused under atmospheric conditions which happen to create temperature gradients.

Most manufacturers build large capacity transformers for various permissible decibel values. However, the prices are high — increases as much as 30 per cent of base price may be demanded for moderate decibel reduction — which may still prove inadequate to prevent noise complaint from neighbors.

Design changes for reducing noise at the source include modification of transformer core, sound-isolating barriers between tank and core, vibration isolation of core, and either stiffening or making more flexible the tank plates and the external supports resting on the foundations. Such modifications have not been uniformly successful, and there are still differences of opinion on propriety of the standard methods in use for measuring transformer noise at the manufacturers' shops and at other points of inspection, and again after installation in the field.

Many types of transformer enclosures and barriers are in use for confining noise. Single walls along one side are reported to give attenuation 10 to 15 decibels, while a complete surrounding house may obtain 20 to 25 decibel reduction. Four walls, with partial roof or with no roof, have also been used, as illustrated in Fig. 7. Underground vaults with ventilation openings acoustically shielded are generally successful.

The literature of transformer-noise investigations, theories, and practical applications is voluminous. Continued cooperation between electrical manufacturers and public utilities is needed to obtain satisfactory and economic solutions of this noise problem.

Figs. 1, 3, and 7 by courtesy of Burgess-Manning Company. Figs. 4, 5, and 6, Florida Power & Light Company. Fig. 2, Consolidated Edison Company of New York.

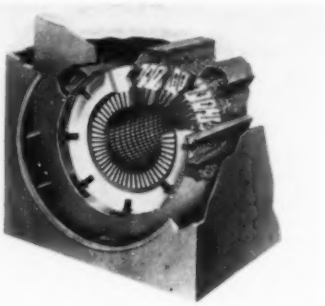
Modern Motor Design

INCREASED RELIABILITY of modern power plant auxiliaries is emphasized by this completely redesigned Allis-Chalmers 2 pole squirrel cage boiler feed pump motor. Here are some of its main features:

Bearing vibration is limited by designing motors with critical speed safely removed from operating speed. Capsule-type bearing used successfully for slow speed motors has been redesigned for high speed operation. Bearing housing has pressure relief to prevent oil vapor pressure building up, and pressurized air from motor's fan acts as a seal to keep vapor from the windings. In addition to forced lubrication, oil rings are provided for emergency use.

Practically all noise in a 3600 rpm motor is windage. Centrifugal fans are used instead of axial, and long air passages are used to reduce noise.

Spiral ventilation, used successfully for large generators since 1937, is used for cooling stator core and windings. Portion of yoke behind winding is alternately divided into air intake and exhaust compartments, so the air has to take a circuitous path through laminations and windings, thus ensuring efficient cooling action as well as reduced noise.



Spiral ventilation of stator core and windings gives efficient cooling in addition to low windage noise

The rotor is very strong. The end rings are forged bronze and rotor rods are pure copper, with oxygen removed to prevent embrittlement while being silver brazed into the end rings.

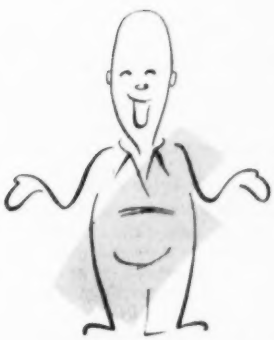
Stator coils have modified Class B insulation for the larger sizes. Balancing at the plant is to within 0.0001 in. at operating speed. Magnetic center is indicated on an instruction plate attached to the bearing.

These and other design modifications ensure absolute reliability for these motors, which are usually among the most important auxiliaries in any plant.

Safety Boner

NO! NO!

SEE ? ? . .



THIS WAY

Natural Gas to be Liquefied and Transported by River Barge

Liquid natural gas at atmospheric pressure is extremely cold (minus 258 F) and is easily transportable in properly insulated tanks. Refrigeration is a valuable by-product, and this new technique may open up many remote waterside natural gas fields while supplying natural gas to users remote from pipelines or not having access to pipeline gas for their purposes

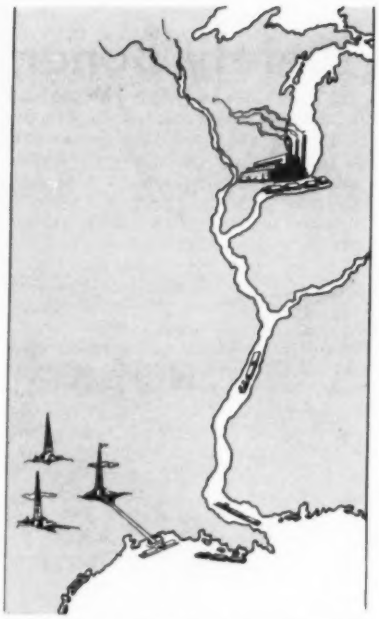


Fig. 1. Route followed by tank barges to Chicago

THERE HAS BEEN developed a novel but thoroughly practicable method for the liquefaction and transportation of natural gas in insulated tanks. The project was assigned to Willard L. Morrison and Associates of Lake Forest, Ill., by private interests that required industrial fuel in the Chicago area. While these interests are not entering the natural gas business, or the transportation business, it is possible that future licensing will permit others to employ the techniques and equipment commercially.

Fuel and Refrigeration

Equipment is under construction by this group to supply both natural gas fuel (18,000,000 cu ft per day) and refrigeration (more than 900 tons) for industrial use in the Chicago area. In this case, natural gas from wells in Louisiana will be liquefied in a barge-mounted liquefaction plant at the gas field, transferred to balsa-insulated tanks mounted in river barges, and towed upstream by dual fuel, natural-gas-powered towboats. The towboats will be powered by vapors released by the small amount of heat absorbed by the liquid through the insulation en route. At the point of delivery, tremendous quantities of heat are required to vaporize the liquid for use as fuel in an industrial establishment. This heat (259,000,000 Btu or more per day) will be taken from cold storage buildings, thereby supplying an equivalent of 900 tons or more of refrigeration. This amount of refrigeration will chill, freeze, and supercool about 725 tons of food per day to zero F.

In general principle, the liquefaction process is not particularly new or complicated. It can be followed by referring to Fig. 2. In the case shown here, gas at well or initial pressure, say 2500 psia, is initially expanded to about 1000 psia, dropping its temperature and removing in separation equipment the heavier hydrocarbons. It then is piped onto an amine contactor and onto a drying tower where CO_2, water and other undesirable constituents are removed.

The resulting gas, principally methane, is precooled by the gas after it was initially expanded, and is then delivered at plus 10 F to a mixing valve, where it joins with other low-temperature gas. The mixture passes through a turbo-expander in which it is expanded to atmospheric pressure and the atmospheric pressure liquefaction temperature of minus 258.6 F. An appreciable percentage of the methane will be condensed to liquid, and appreciable power will be developed by the turbo-expander.

For the application under consideration, the uncondensed gas is compressed to 1000 psia (there being no particular use for this low-pressure gas locally) and the cold gas *before* its compression precools the same gas flow *after* compression to about minus 95 F. The precooled gas at 1000 psia is delivered to the mixing valve mentioned.

All power developed by the turbo-expander is applied to the gas compressors. Its total output, however, is less than the total compression power requirements, and this additional power is supplied by a steam turbine connected to a common shaft. Boiler fuel can be tapped off at a suitable compression stage (see Fig. 2). About one-sixth of the total required compression power is supplied by the turbo-expander, the remainder being supplied by the steam turbine.

Cooling Water

The barge-mounted liquefaction plant could operate in brackish or sea water as well as fresh water since the steam cycle is closed, and such water can be used for gas intercooling, aftercooling and steam condensing. Cooling water at the Louisiana location runs about 80 F, which permits economical interstage and aftercooling to 100 F. Aftercoolers are supplemented by the precooler, as described in the liquefaction cycle.

Proper insulation is not the only factor involved in the success of this system, but it does make success possible. A very satisfactory method has been devised (and proved through experimentation) to apply balsa insulation to the tank interiors. This permits atmospheric storage of liquid methane in metal tanks without subjecting the metal to the very low temperature of the liquid and without appreciable absorption of heat. Since the metal is isolated from the low-temperature gas, it remains at ambient temperature.

Tank barges for the project under discussion will have double hulls and contain five tanks each, with a barge capacity of 35,000 bbl or more. The space between hulls can be flooded to control the barge draft and constitute an additional safety factor in the event of collisions. Each of the insulated tanks has auxiliary equipment for the controlled evaporation of fuel and the chilling of brine for refrigeration duty. Each tank can also dispose of vapors released in excess of fuel requirements in the event of long layovers en route or at point of delivery. Normally, gas vapor vented in an emergency would be diluted with air to a non-inflammable mixture.

Additional safeguards are required to prevent the occurrence of explosive mixtures in an evacuated tank, and this is simply accomplished by the loading of 1.75 cu ft of dry ice (solid CO_2) for each 1000 cu ft of tank volume. Evaporation of all methane will result in increasing temperatures in the tank, and dry ice will sublimate into CO_2 gas to purge the tank of all other gases. Dry ice is used in the same manner to purge air from the tanks before putting them in service.

Evaporation

Low temperatures within the tanks assure that any flow of heat will be inward, hence a continuous evaporation which assures that all vapor flow will be outward. So long as this prevails, there will be no inward breathing of oxygen-bearing air into the tank. Dry ice continues this pressurization when and if all methane is expanded. Normally, however, some methane is left in the tanks to

fuel the towboat on its return voyage.

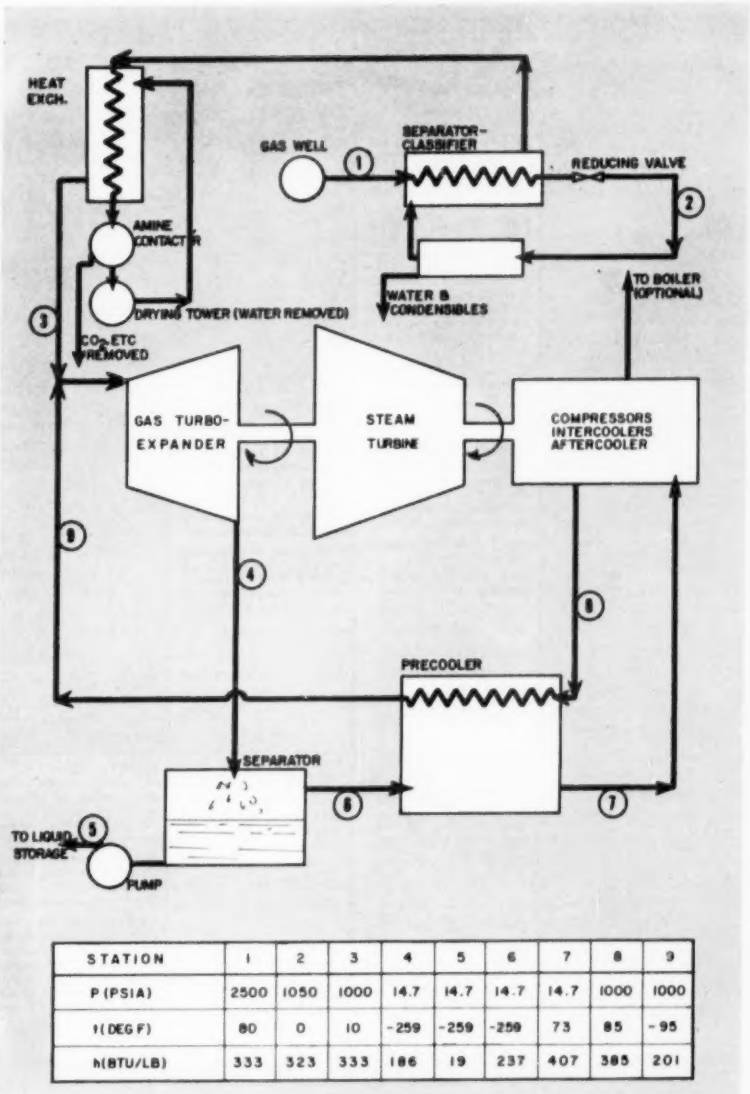
In this system, refrigeration and fuel vaporization equipment are synonymous and consist of a methane boiler, methane vapor superheater, and a shell-and-tube type brine chiller. The methane boiler element is located at the bottom of a central column of each storage tank (see Fig. 3), and the superheater is located above it at the top of the column. A specially developed low-temperature heat transfer medium (fluid to minus 265 F) is pumped through the superheater and into the boiler. From the boiler, it returns to the shell-and-tube brine chiller outside the tank. Flow rate of the heat transfer medium is determined by required fuel evaporation. It is conducted from the tank to the brine chilling apparatus through concentric tubing, the warm fluid being in the outside tube.

Economics

Equipment investment for a gas bargeline and liquefaction plant is much less than that necessary for a pipeline and pumping stations of similar capacity. Furthermore, liquid methane fuel can assure a gas supply to an industrial user without regard to domestic gas load in his locale. In some plants where continuous fuel supply is a must, freedom from periodic fuel changeovers could reduce manpower requirements by one shift operator (see "Manpower Operating Costs," page 88, May issue).

Detailed cost comparisons based on $6.69 per ton coal and $0.059 per gallon fuel oil (in Chicago) shows coal costs 3.39 cents per therm, fuel oil 3.93 cents per therm. Liquid methane is in a very strong competitive position with the above prices and its position is further improved by the value of refrigeration, in addition to its obvious desirability as a fuel. One ton of refrigeration is the by-product of each 20 to 22 MCF of gas evaporated and warmed. This corresponds to a minimum of 5 cents per MCF for refrigeration as an added value. In some instances, this very low temperature could be used to considerable advantage and would be worth more. It might be said that incidental to the transport of liquid methane at atmospheric pressure, there is transported one ton of refrigeration for each 20 MCF of standard gas, available at the transport terminus.

Liquid methane as a fuel and refrigerant is both economically and technically practicable when the need for large amounts of refrigeration and fuel are added to inexpensive water transportation. Doubtless, we shall see a great deal of this in the future, possibly in the form of transocean shipment of gas fuel *from* remote gas fields without nearby populous areas *to* populous areas without nearby gas fields, without mentioning the possibility of refrigeration en route. Its use in refrigeration ships and for the quick-freezing of foods is imminently feasible, and this too will undoubtedly be explored.



STATION	1	2	3	4	5	6	7	8	9
P (PSIA)	2500	1050	1000	14.7	14.7	14.7	14.7	1000	1000
t (DEG F)	80	0	10	-259	-259	-259	73	85	-95
h (BTU/LB)	333	323	333	186	19	237	407	385	201

Fig. 2. Gas processing and liquefaction cycle, with pressures, temperatures and enthalpies per stage

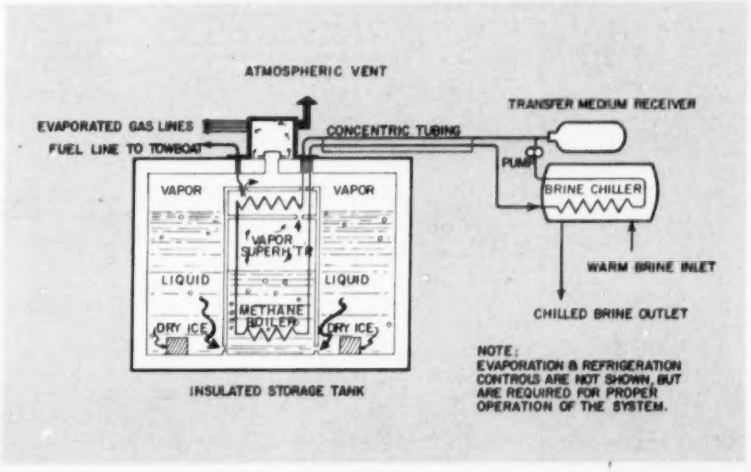


Fig. 3. Liquid methane storage tank showing the vaporization and refrigeration equipment and dry ice

Factors in Welding and Brazing Heat Exchanger Tubes

LEGEND

SMAW = Shielded metal arc welding (coated electrodes).

IGMAW = Inert gas metal arc welding (also called Heliweld or inert gas tungsten arc welding process).

BRZ = Brazing.

BR.W = Braze welding (can be applied with oxyacetylene torch, SMAW, or IGMAW; torch is used unless otherwise specified).

(H) = Helium-shielded arc.

(A) = Argon-shielded arc.

(CHF A-C) = Continuous high frequency a-c welding power supply.

(+D-C) = Straight-polarity d-c welding power supply.

NOTE: Welding rod or filler metal classifications listed after the welding methods conform to AISI, ASTM, and/or AWS specifications.

	Carbon and Low-Alloy Steels	Stainless and Chromium Steels	Copper and Copper Alloys	Nickel and Nickel Alloys	Aluminum and Aluminum Alloys
Carbon and Low-Alloy Steels	SMAW: EXX10, EXX11, EXX15, EXX16. Sometimes use EXX12 and EXX13. BRZ: BAg, BCu, BCuZn, BNiCr, BAgMn. BR.W: If using IGMAW, adhere to following: (H or A), (+D-C), AISI Types 308, 309 or 310. Covered electrodes E308–15, E308–16, E309–15, E309–16, E310–15, or E310–16. Use of copper alloy fillers requires use of (CHF A-C) and RCuAl-A1 or RCuAl-A2. If using SMAW, use copper alloy electrodes ECuAl-A.				
Stainless and Chromium Steels	IGMAW: (H or A) with (+D-C), or (A) with (CHF A-C); filler matching stainless or of higher alloy to offset dilution of stainless by low-alloy steel. SMAW: Filler matching stainless or of higher alloy. BRZ: Filler BAg, BNiCr or BAgMn.	IGMAW: (H) (+D-C); AISI specification in preparation. Use rods matching base metal analysis or with higher alloy. SMAW: Covered electrodes of same or higher analysis. BRZ: When thickness ratio exceeds 4:1. BAg, BNiCr and BAgMn. High-temperature service within individual limits, BNiCr and BAgMn.			
Copper and Copper Alloys	BR.W: When by SMAW, use ECuAl-A stick electrodes. If using IGMAW, use RCuAl-A2 filler. BRZ: Use BAg class, especially BAg-1, BAg-2 or BAg-3 filler metals.	BR.W: Applied with IGMAW (A) (CHF A-C). Use RCuAl-A1 or RCuAl-A2. BRZ: Use BAg-1, BAg-2 or BAg-3 for best results.	IGMAW: (H) (+D-C) or (A) (CHF A-C). For de-oxidized copper use RCu filler. For silicon bronze, use RCuSi-A. For aluminum bronze use RCuAl-A2. BRZ: Use BCuP, BAg or BCuZn fillers. When brazing aluminum bronze, use special flux to treat aluminum oxide. BR.W: IGMAW (H) (+D-C) except for aluminum bronze which requires (A) (CHF A-C). Use RCuSi-A or RCuAl-A2, though former is given to hot-short cracking and latter requires (CHF A-C) welding.		
Nickel and Nickel Alloys	BR.W: When by SMAW, use covered nickel electrodes except for inconel; in this case use inconel electrodes. If using IGMAW, use same in bare form. BRZ: Use BAg-1, BAg-2, BAg-3, or BCuZn-6.	BR.W: Applied by IGMAW (H), (+D-C) or by SMAW. Fillers for both processes substantially the same, except covered for SMAW. For stainless steel to nickel, use inconel, nickel or stainless steel composition filler. For stainless steel to monel, use monel or nickel filler. For stainless steel to inconel, use inconel or stainless steel filler metal. BRZ: Use BAg-1, BAg-2, BAg-3, or BCuZn-6 filler metals.	BRZ: Use BAg-1, BAg-2 or BAg-3.	IGMAW: (H) (+D-C). Duplicate base metal for filler when tube and sheet are of same metal. Combinations of nickel and monel require either nickel or monel rod; nickel and inconel require either nickel or inconel; inconel and monel require monel, nickel or inconel. All are of special analyses for inert gas arc welding. SMAW: Same general filler metal requirements as given except with covered electrodes. BRZ: Use BAg-1, BAg-2, BAg-3, or BCuZn-6.	
Aluminum and Aluminum Alloys	BRZ: Use BAlSi-4 filler metal with special aluminum brazing flux applied to both members. Usually done in a furnace.	Not a practical operation at this time.	Not a practical operation at this time.	Not a practical operation at this time.	IGMAW: (A) (CHF A-C). For heavy sections, high-voltage a-c equipment with high frequency arc starting is used. For welding 2S and 3S, use 2S filler metal; for 52S, use 43S filler; for 61S, use either 43S or 54S filler. When base metal is high-purity aluminum, filler should match the base in purity. An AWS-ASTM filler metal specification is in preparation. BRZ: Special flux suited to composition is required. Filler metal for 2S and 3S is BAlSi-A (43S); for 54S and 61S, use BAlSi-4 (718). Base metal precoated with filler metal is available, but flux must be removed.

Welding or brazing tubes to tube sheets presents problems in joint design and electrode or filler metal selection, the answers being dependent on relative thicknesses of tube and sheet and their combinations of metals. This article integrates all of the factors for you

BEFORE WELDING or brazing tubes into tube sheets it is wise to investigate the metal analyses, relative thicknesses of metals (tube and sheet), and available welding or brazing equipment. A recent ASME paper (No. 53-A-175) presented by H. A. Huff and A. N. Kugler shows the inter-relation of these factors and their effect on choice of joint design and joining method. Their conclusions are summarized in the following article.

Basic joint designs specifically for the joining of tubes to tube sheets are shown in Figs. 1 through 5. If both the tube and sheet are of identical metals, the choice of joint type is simplified and becomes primarily a question of relative thickness of the tube and sheet. It is extremely difficult to weld tubes to a sheet when the relative thickness exceeds a ratio of about 4:1, hence these joints would probably be brazed. This assumes that the size and construction of the heat exchanger are such that brazing is possible and a suitable means of heating is available. If welding is used, it is often desirable to roll the tube in place and then add the weld.

In brazing, despite some tendency to burn a thin-walled tube in a heavy sheet, the joint shown in Fig. 1 is generally preferred. When brazing any joint, clearance between the tube and sheet *at brazing temperature* should be in the range of 0.002 to 0.006 in. for optimum strength and reliability. This allows the filler metal to flow by capillary attraction into the clearance space, leaving the minimum cross-section of the filler for a given bonding effect. With some metals (aluminum, for example) joint clearance may be as high as 0.010 in.

Extending the tube beyond the sheet, as in Fig. 2, permits depositing a fillet weld at the juncture thus created and simplifies the welding operation. This joint is well adapted to inert-gas tungsten-arc welding and metal-arc welding with stick electrodes where a simple fillet weld would meet stress requirements. Large sheet-to-tube thickness ratios will make good fusion of the sheet difficult and increase chances of burning the tube.

Recessing the tube end into the sheet, as in Fig. 3, permits depositing a fillet weld at the juncture with metal-arc welding using stick electrodes. Again, large sheet-to-tube thickness ratios make it difficult to avoid burning the tubes. Joints pictured in Fig. 4 are a modification of the welded joint shown in Fig. 1 which permits depositing a full-section single bevel groove weld. Such a weld is distinctly superior to that shown in Fig. 1, but is somewhat difficult to make in the large numbers required in a typical heat exchanger. The best welding technique here is the metal-arc with stick electrodes, though inert gas-tungsten arc welding may be used.

A joint particularly suitable for brazing tubes into sheet metal sheets is shown in Fig. 5. Perforations in the sheet are made by punching, which leaves a short lip to provide additional area for the filler metal.

When dissimilar metals are used for the tubes and sheet, special notice should be taken of the thermal expansion characteristics of each before brazing. If the tube metal has the higher thermal expansion, clearances will tend to close up or even disappear at brazing temperature and it is necessary to allow greater room-temperature clearances. If the tube sheet metal has the higher thermal expansion, clearances at brazing temperature will be excessive. In this case, it may be necessary to use very low clearances at room temperature, but this may lead to difficulty in assembling. In either case, if wide joint clearances are inevitable, use a filler metal with a wide brazing temperature range and typed as a "sluggish flow" filler to bridge the wide gap between the tube and sheet.

Since the tubes and tube sheet may be either of similar or dissimilar metals, the chart on the opposite page has been prepared to show combinations likely to occur and how to handle them. The order in which the welding or brazing processes are listed indicates their relative preference for the specific applications; there is no particular significance to the order of filler metals listed unless otherwise noted. When selecting a filler metal, however, it is always necessary to investigate the compatibility of the metal with the fluids and temperatures in the heat exchanger.

Three dissimilar metals combinations given in the chart (stainless to aluminum, copper to aluminum and nickel to aluminum) are not discussed. Joining these combinations by present welding or brazing processes is not considered practicable at this time.

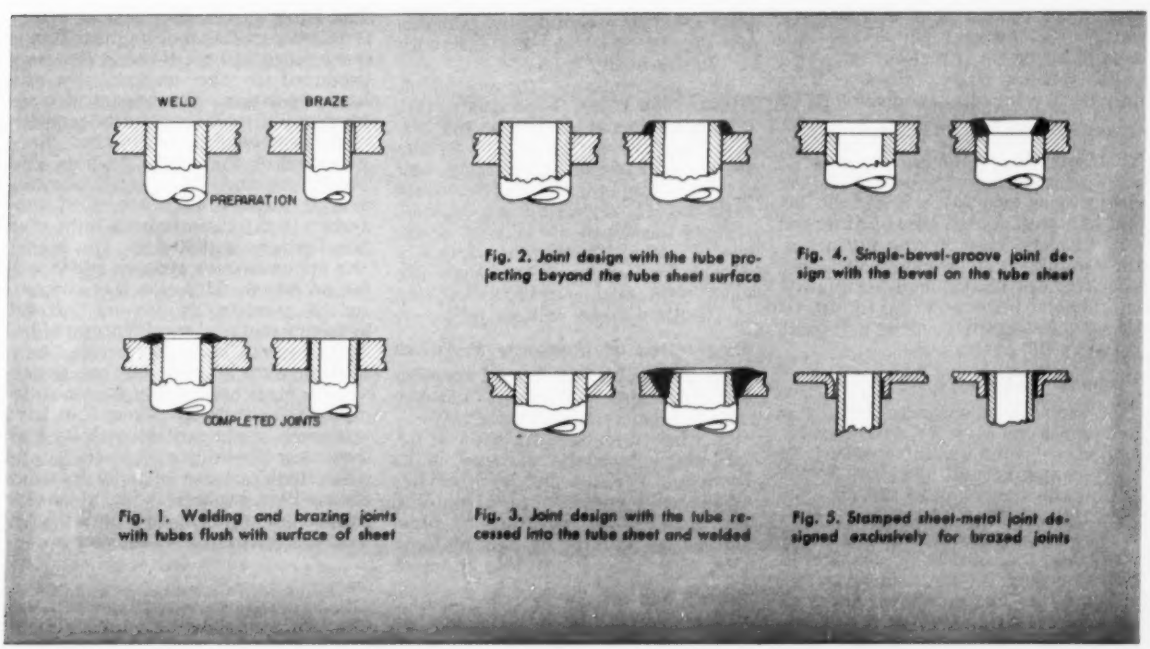


Fig. 1. Welding and brazing joints with tubes flush with surface of sheet

Fig. 2. Joint design with the tube projecting beyond the tube sheet surface

Fig. 3. Joint design with the tube recessed into the tube sheet and welded

Fig. 4. Single-bevel-groove joint design with the bevel on the tube sheet

Fig. 5. Stamped sheet-metal joint designed exclusively for brazed joints

Past few years have seen many advances in the use of carbide tipped tools for concrete and masonry drilling. This article describing how the properties of concrete and masonry affect bit types is the first of several we are presenting to explain basic principles and latest developments in the technique of masonry drilling

By BERNARD L. CHAPIN* and RALPH H. ALPER†

Fig. 1. Rotary bit, pointed, with single carbide tip

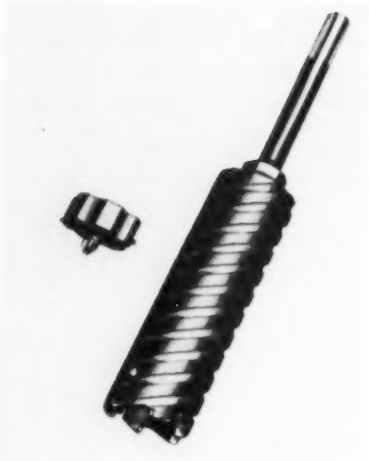


Fig. 2. Rotary bit, core-type, with multi carbide tip

MASONRY DRILLING

THE past few years have seen many advances in the use of carbide tipped bits for drilling different kinds of masonry material.

New design, as well as a better understanding of the techniques required in applying these tools, have widened the range of application of carbide bits. It is certainly time to take note of the tools which are available, and to consider certain basic principles governing the application of these tools to any drilling job.

Carbide tipped bits fall into two broad categories. First, the Rotary Bits, used in portable electric drills, drill presses, rotary air drills, and even hand braces. Second, the Percussion, or Hammer Bit. These are used in air or electric hammers.

All carbide tipped Rotary Bits may be further sub-classified:

Group 1 — The Pointed Bit

This type of bit is the least expensive, and most commonly used bit. Its single tip is inserted in a slot at the end of a steel shank. Bits of different manufacture vary in the fluting of the shank, the amount of steel "backing up" the tip, and the quality and type of braze securing the tip to the shank. Figure 1 shows a typical masonry bit of this type.

Group 2 — The Core Bit

The core bit is characterized by a hollow central core. These are multi-tipped tools, and a number of carbide tips are set around the core in the end of the steel shell of the bit. The variation in this bit from one manufacturer to another exists in the type of fluting, the number of tips, and in the tip design. Figure 2 shows a typical core bit. The bit shown has a removable starting center for quick, accurate starting, usually unattainable with core bits.

Group 3 — The Coreless Bit

This type of bit is a multi-tipped bit, generally manufactured only in small diameters. This is basically the core type bit, because tips are set about the center of the bit, but no core is present. See Fig. 3.

The Hammer Bits presently available for use in the light portable hammers are divided into two groups.

Group 1

The single-tipped type shown in Fig. 4.

Group 2

The core type — a multi-tipped hammer bit analogous to the rotary core bit, as shown in Fig. 5.

The best solution to any given drilling job must, of course, start with the selection of the proper bit. A drilling job can be defined by the particular material to be drilled, and the hole diameter. Of course, other variables of secondary importance, such as the depth of the hole, direction of drilling (horizontal, vertically upward or downward, etc.) may also have to be considered in the solution of a contemplated drilling job.

Properties of Masonry Material

At this point, we should consider the properties of different masonry materials affecting drillability.

A very common term used in describing a masonry material is its hardness. For the purposes of this article, the hardness of a material will indicate its resistance to penetration by the tip or tips of these bits, when bit is forced into material.

Rotary Bits

What, then, would be the effect of an extremely hard material such as granite on a rotary bit? The pressures required to cause the tips of such a bit to penetrate this material of extremely high hardness would be correspondingly high. In fact, they are so high as to make it impractical to drill materials as hard as granite with rotary carbide tipped bits. However, the effect of granite aggregate in a concrete is similar, yet it can, in most cases, be drilled with these rotary bits. It is therefore quite obvious that a limiting property of masonry is its hardness, that is, for rotary bits.

Hammer Bits

The effect of the hardness of a material on percussion or hammer bits is quite different because of the stresses produced in the material by the hammer action. The impact stresses produced by hammer are momentarily many times greater than those produced by the steady pressure on a rotary bit, and, as a result, penetration is possible in the hardest material. It is interesting to note that the harder the material, the higher the instantaneous stresses which will be produced. This last fact conveniently permits drilling of hardest masonry materials with hammer bits.

The advantages of a carbide tip on a percussion bit now become apparent. A steel bit quickly becomes deformed by the high stresses in hard materials while carbide with its high hardness is readily able to withstand these high stresses without deformation. This explains why a carbide tipped hammer bit will outlast steel star drills from 30 to 100 times.

*Executive Vice-President and †Development Engineer, New England Carbide Tool Co.

Fig. 3. The same as Fig. 2, but for 5/16 or 3/8 in diam

Fig. 4. The hammer bit, pointed, single carbide tip

Fig. 5. The hammer bit, core-type, multi carbide tip

—Which Bit for Which Material?

It can then be seen that with respect to percussion bits the hardness of a masonry material is not a limiting factor in their application.

Another important property of masonry material which affects its drillability is abrasiveness. Concrete, clay products, much stone such as sandstone, limestone, etc., consist of discrete particles which are cemented together with a binder.

The size, shape, and physical properties of the individual particles most likely determine the abrasiveness of the material. A convenient way to think of these materials is to consider that the stronger the binder, and more closely packed the individual particles, the greater the hardness of the material or the more difficult it is to penetrate it.

It is therefore obvious that a material with a weak binder and relatively loose packed particles might appear soft (that is, readily penetrable), but nonetheless, if the individual particles are of such a nature as to be extremely abrasive, then a rotary bit used to drill such a material would dull rapidly.

An extreme case, of course, would be a material with abrasive particles, close packed and strongly bonded with a binder that itself may, when broken up, degenerate into an abrasive—vitrified tile, for instance.

Materials like granite and marble which are crystalline can have similar conditions of incongruous combinations of hardness and abrasiveness. Marbles of extreme hardness do exist, for instance, but their abrasiveness is generally less than that of many softer sandstones.

The effect of an abrasive material on a rotary bit is to limit the bit life. When drilling a soft, abrasive ma-

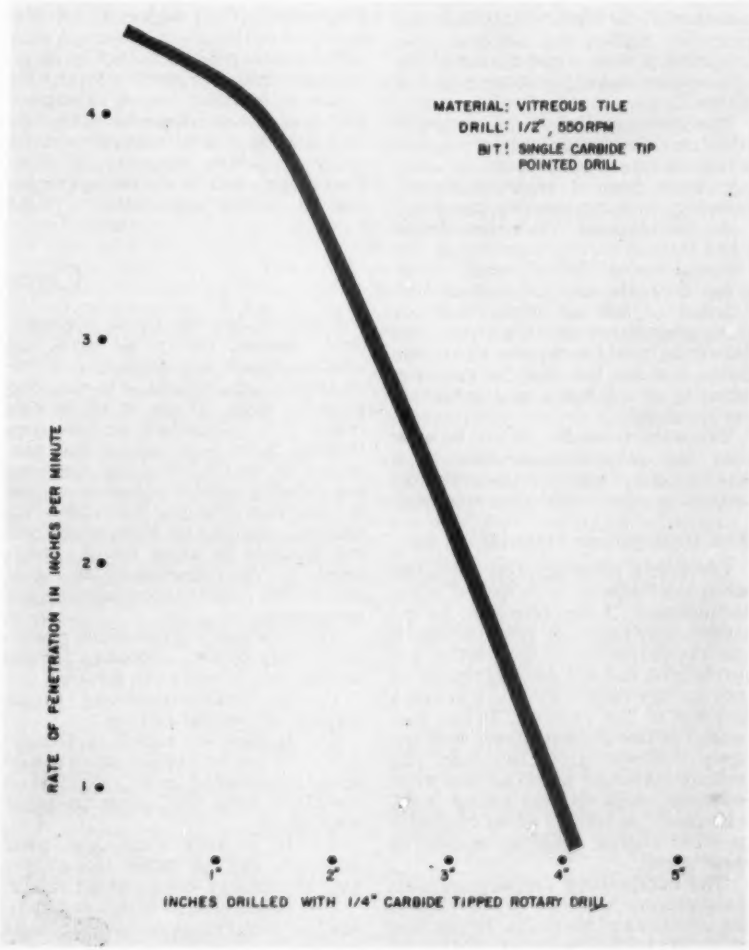


Fig. 6. Abrasive effect of glazed vitreous tile showing rate of penetration compared to depth of hole

terial, initial drilling rate will be high, and drilling will be surprisingly easy. After a very short time, however, the drilling rate will fall off sharply and suddenly. Figure 6 shows this effect in glazed vitreous tile.

Hammer bits are much less affected by the abrasiveness of the material. Why this is so can only be surmised. Hammer bits apparently do a great deal of their work by the transmission of energy of the blow by means of impact waves through the material and thereby cause pulverization of materials with which the tips never come into contact.

The properties of hardness and abrasiveness in masonry materials are therefore more limiting factors in rotary bit drilling than in hammer bit drilling. As will be seen later on, good bit design stretches these limits, lengthens bit life, and increases rates of penetration.

Another factor which affects bit design is the bulking characteristics of the material being drilled (bulking is the quantity of powder produced as the hole is drilled). Softer materials bulk up more, and since the rates of penetration in softer materials are generally higher, the required volume rates of flow of powder out of the hole are necessarily greater in softer material.

The ultimate effect of these properties on either rotary or hammer bits is to limit rate of penetration by loading flutes beyond their maximum carrying capacity, causing jamming.

A complicating condition arises when there is moisture present in the material being drilled, such as in green concrete and other masonry, exposed to rain or snow, and not completely dried out. Here the powder or bulk will compress about the flutes, and set, reducing the carrying capacity of the flutes, and accelerating jamming.

From the foregoing, it can be seen that the proper application of a specific type of bit depends on several properties of the masonry material.

Non-Homogenous Material

Obviously complications can arise when the material to be drilled is not homogenous. A concrete slab, for instance, may have any combination of the above-mentioned properties depending on the mix and aggregate, as well as the excess moisture content and age of the concrete. It can also consist of two or more layers with entirely different properties, and can contain materials which are not even masonry, such as reinforcing rods, wire mesh, as well as ducts of plastic or other organic material or even of sheet metal.

The outstanding property of nonhomogenous material is, of course, the contrasts of hardness. In the case of a rotary bit, passage of the tip from hard to soft material can set up excessive impact stresses in the tip, and produce tip breakage unless the bits are specifically designed to withstand such shock. A rotary bit passing over alternate hard and soft spots may also be subjected to a great deal of chatter and vibration.

It might be interesting to consider why the three types of rotary bits (1. Solid Pointed Bit; 2. Core Bit; 3. Coreless Bit of Core Design) have different ranges of material they will cut on the basis of their design.

Simply stated, a tip cuts only when in motion with respect to the surface it is penetrating. The linear velocity of any point on the cutting edge of the tip depends on the distance from the center. At dead center, there is no motion, therefore, no cutting. A solid pointed bit, encountering a piece of aggregate head on, would have to be forced into the aggregate a considerable distance before active cutting edges some distance from the center can begin to cut. In contrast, a core bit meeting a pebble head on, has cutters with the entire cutting edges in motion at good linear speed; then you get cutting.

In fact, the limiting factors in selecting a rotary carbide tipped bit for drilling concretes are the absolute properties of the *aggregate*. A few examples of this are: 1. Concrete with milky quartz pebbles cannot be satisfactorily drilled with any rotary bit — use a hammer bit. 2. Concrete with traprock or bluestone cannot be drilled with a solid carbide pointed bit — use a core design bit. 3. Concrete with small limestone aggregate can be drilled with either a solid carbide pointed bit or either type of core design.

This shows that the kind of aggregate in the concrete determines the design of bit to use.

Even rotary carbide tipped core bits cannot cut all aggregates. There is a limit to the concrete these bits will drill under ordinary methods.

For the harder concrete materials we turn to carbide tipped hammer bits. With hammer bits, it is important to note that the aggregate does not limit the range of application. This is because the hardest aggregates are readily pulverized by hammer bits, be they met head on or eccentrically.

Thus far, it is apparent that the range of application of hammer bits is far more extensive than that of the rotary bits. Actually, there is no limit to the masonry materials carbide tipped hammer bits will drill, but the *line must be drawn* in practice at the extremely *brittle materials*. Tiles, for instance, though they are readily penetrated by hammer bits, will not withstand the hammer blows, and will crack. The drilling in thin sections of brittle materials, like some marbles which have a grain, will also cause splitting of the material. It is possible to drill material of this nature with hammer bits when hole diameters are very small, and the hammers very light. When the material is set in a wall or floor, this problem is also somewhat alleviated. Brittleness is, therefore, the only property of the material which can limit the application of hammer bits in the range of hard materials.

Corrosion-proof Concrete

Concrete can be made corrosion proof against nearly all acid and alkaline splash and spillage by brush or trowel applications of a modified phenolic resin. Floors so badly corroded they permitted acid to seep through have been coated and protected for nearly two years, the coating showing neither attack nor wear in that time. The new material solves the long standing problem of protecting concrete in areas where investment in, or replacement by, acid proof brick is either too costly or time consuming.

The new coating combines practically every quality necessary for use on concrete in corrosive service.

1 — It bonds completely to an alkaline or neutral surface.

2 — It does not shrink in setting.

3 — It can be applied by brush or spray as furnished, or by trowel when combined with flint silica or other inert fillers.

4 — It is very hard and wear resistant, can be made smooth for easy cleaning or slip-proof for safety.

5 — It resists acid splash and spillage, is impervious to caustic soda and to almost all solvents, hot or cold.

6 — Surface preparation requirements are simple. Application can be made quickly, curing time is 8 to 24 hours.

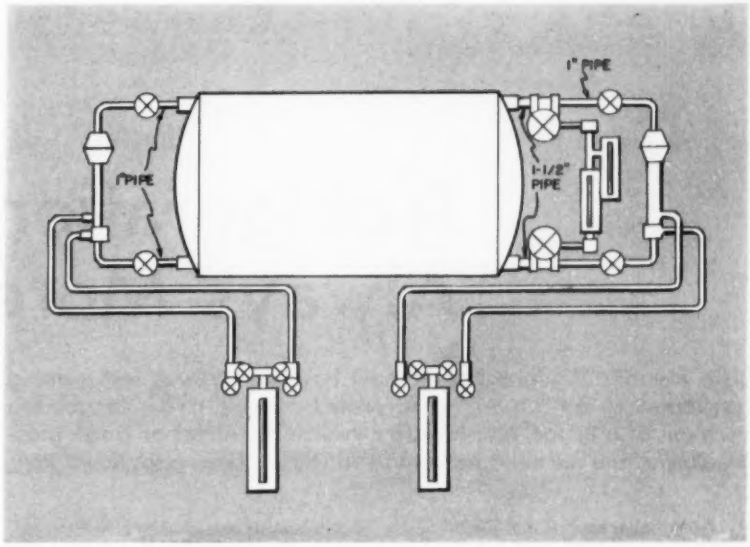
7 — It can be applied on old or new concrete.

Continuous immersion in hot, concentrated acids will attack the phenolic resin slowly. This susceptibility to attack is lessened by the substantial flint silica addition invariably used for floor service. Acid spillage on floors is rarely — if ever — severe enough to affect the resin.

Use in troughs, tanks and sumps, for continuous acid immersion service, should be preceded by tests. Plant experience has shown that the resin completely protects the flint silica filler from attack by either concentrated caustic soda or dilute hydrofluoric acid. For special applications, other fillers such as tabular alumina and carbon powder are available.

For more information on this new product write Corrosion-proof Concrete on one of the prepaid post cards elsewhere in this issue and mail it to us.

Every power engineer should be familiar with the ASME Boiler Code, but many are not. He needs the Code in order to understand the characteristics of his plant, the rulings of inspectors, what he is allowed to do, and what is forbidden. From time to time we will present short items from the Code to show what it has to say about various aspects of modern boiler operation. Here is latest ruling of the Code Committee on subject of boiler water level gage glasses



Remote indication of boiler water level as shown in diagram is now permitted for pressures over 900 psi

What the Boiler Code Says About Gage Glasses

IN 1911 The American Society of Mechanical Engineers appointed a committee to formulate standard specifications for the construction of steam boilers and other pressure vessels and for their care in service. This committee has since come to be known as the Boiler Code Committee.

Though the Code has been formulated to cover as wide a range of conditions as possible, every now and then situations arise which are not covered by a ruling of the Code. When this happens an inquiry is made about these particular conditions, and the Committee meets at regular intervals for the purpose of considering these inquiries about the Code.

For many years the basic primary element for indicating high pressure boiler drum water level has been the water gage. The present ASME Power Boiler Code (1952) requires two such gages as stated in the following quotation from paragraph P-291:

"Water Glasses. Each boiler shall have at least one water-gage glass except that boilers operated at pressures over 400 psi shall be provided with two water-gage glasses which may be connected to a single water column, or connected directly to the drum. . . ."

During the last few years many types of remote indication for showing the boiler water level some distance from the boiler have been used, and these devices have been growing increasingly reliable. This increased reliability prompted an investigation of the suitability of remote manometric type indicators as substitutes for gages as primary indicating elements. Several such indicators were recommended as a result of this investigation, and the ASME Boiler Code Committee was then asked to consider the substitution of these devices for the direct connected gage. The Committee duly considered the request, and approved it. This approval was published as "Case No. 1155" (Interpretation of Par. P-291 of the Power Boiler Code) which reads as follows:

"It is the opinion of the Committee that two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi. When both remote indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

"The remote indicators shall not depend for operation upon any external source of energy. Connections to the drum shall comply with present rules Par. 293 and P-320 for water columns and shall be completely independent of connections for other functions."

On this last sentence, i.e. that connections to the drum shall be completely independent of connections for other functions, The Secretary of the National Board of Boiler and Pressure Vessel Inspectors gave the following opinion: "we interpret the words 'for other functions' in the last sentence of Case 1155 to mean functions other than that of indicating water level. Therefore, the connections of more than one water level indicating device to the same drum openings is not prohibited by the Code and it is permissible to connect a remote gage and a direct gage to the same piping provided, of course, that all other Code requirements are met."

It will be seen that the ruling permits but does not compel. It offers the high pressure (over 900 psi) boiler plant operator certain advantages. Drum water level can be checked more easily with an indicator at eye level, particularly when the great height of large modern boilers is considered, and the use of mirrors for light transmission can be reduced to a minimum. In addition such an indicator offers a double check on drum water level, and results in a reduction of gage maintenance.

In some states visual observation of the boiler gage glass is enforced by law, and this interpretation by the Code Committee will naturally not affect the existing law. However, the Committee, by establishing the rules for good modern practice, paves the way for future revisions of the law to keep pace with developments in measuring and indicating equipment.

In addition to quoting appropriate extracts from the Code, from time to time we will publish interpretations of the Boiler Code Committee, as well as interpretations of the Committee on the Code for Unfired Pressure Vessels.

Finally, as soon as the latest revision of Suggested Rules for Care of Power Boilers is off the press, we will publish extracts from that also.

Refrigeration Plants . . . Always More Problems

Case histories described here show how money was lost burning crankcase oil, by wasting condensate, and by trying to get too much out of a motor. Also how to minimize the effect of gage glass breakage, and the need for control valves on compressor liquid lines

By C. T. BAKER*

TO WANT TO PAY as little as possible for everything is a very human wish, but most of us have learned by bitter experience that when it comes to engineering equipment, too much initial economy usually turns out to be more expensive in the end. However, the number of examples of false economy I encounter shows that many are slow to learn this lesson. Here is a typical example.

Expensive Free Fuel

An industrial plant operated two self-contained, fully automatic fire tube boilers, each rated at 100 hp. These excellent steam generators were doing a good job, except for one thing — one unit, due to no fault of its own, required constant attention because of the heavy, granite-like substance that was being deposited on the fire side of its tubes. To keep the tubes free, it was necessary to drill out this material every other week, and sometimes oftener.

Two kinds of fuel were used in this plant. The No. 1 boiler burned crankcase oil which was collected from several auto repair shops and filling stations and transported to the plant in a suitable oil tank mounted on a truck. Boiler No. 2 was fired with regular No. 2 fuel oil.

Temperature readings of the flue gases leaving the heating surfaces showed that boiler No. 1, using discarded crankcase oil, averaged 200 F above the temperature it should have had at that pressure. Boiler No. 2, using conventional fuel oil, never exceeded a temperature difference of 100 F.

As far as heating value was concerned, the crankcase oil was surprisingly good — 19,600 Btu per lb, but the labor cost of removing the granite-like deposits from the fire side of the tubes was too expensive and there was always the possibility that the insulating effect of these deposits would cause tube overheating.

A method was found whereby the foreign matter could satisfactorily be removed from the crankcase oil, but the management considered it not worth the effort and finally decided to discontinue the use of the "free" fuel oil.

After the tubes were thoroughly cleaned of deposits, the use of the regular No. 2 fuel oil resulted in the leaving flue gas temperatures dropping to the same point as on the other generator.

Unless facilities are provided in the beginning for the complete removal of foreign matter from crankcase oil, such "free" fuel can prove quite expensive in the end.

Condensate Is Money

Another interesting fact about the operation of this plant was that no hot condensate was recovered for the boiler feed. A motor driven feed pump supplied water to the boilers, and the suction of this pump was connected to a receiving tank which was supplied with city water under float control. Live steam, at boiler pressure, was bled into this tank through a hand-controlled globe valve. Feedwater was heated this way, while the hot condensate from all plant operations was wasted to the sewer. As the bottom of the 38 in. horizontal tank was only 12 in. above the center line of the pump, they had found it impossible to pre-heat the feedwater beyond 110 F, because flashing occurred at the suction inlet.

This is now being changed — the tank will be elevated several feet above the floor, and the condensate that has been going to the sewer for years will be delivered to the collecting tank for use as feedwater. Make-up water will be pre-heated with flash steam from the traps. The arrangement before and after the change is shown in Fig. 2.

Two compressors were installed in a packing plant — one a 9 in. by 9 in. to handle the high temperature load, the other a 5 in. by 5 in. to handle low temperature freezer load. Both operated at a speed of 360 rpm but the larger unit was belted to a 100 hp motor and the smaller to a 10 hp.

The larger unit handled the high temperature load satisfactorily at 25 to 28 pounds suction pressures. The low temperature evaporators were operated at two pounds suction pressure. Condensing pressure varied from 180 to 185 pounds gage, depending upon the load and on the temperature of the condensing water. The suctions of the two compressors were cross-connected to permit either to operate on either load in case of emergency.

When the job was laid out, the plant management was advised that the 10 hp motor on the 5 in. by 5 in. compressor would not be large enough to operate the compressor at the suction pressure carried on the evaporators of the high temperature rooms. It was suggested that a larger motor which could be quickly connected to the small compressor in an emergency be obtained. The owner objected to investing in a larger stand-by motor as he contended that the load on the 5 in. by 5 in. compressor, in emergency, could be held within the capacity limits of the 10 hp motor.

The Overloaded Motor

However, about a year after the completion of the installation, the large machine had to be shut down for about five hours because of motor troubles, so, in order to hold the temperature in the chill room, the 5 in. by 5 in. compressor was connected to this load. No attempt was made to control the loading of this compressor and very soon it became overloaded because of high suction pressure. The motor, consequently, was quickly stopped by the thermal cut-out. To overcome this hindrance, a temporary hook-up was devised, by-passing the starter, which allowed the motor to operate without benefit

*Consulting Engineer

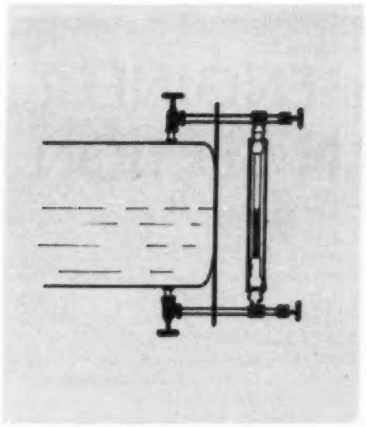


Fig. 1. Valves at receiver prevent refrigerant loss from leaks between the gage glass and the shell

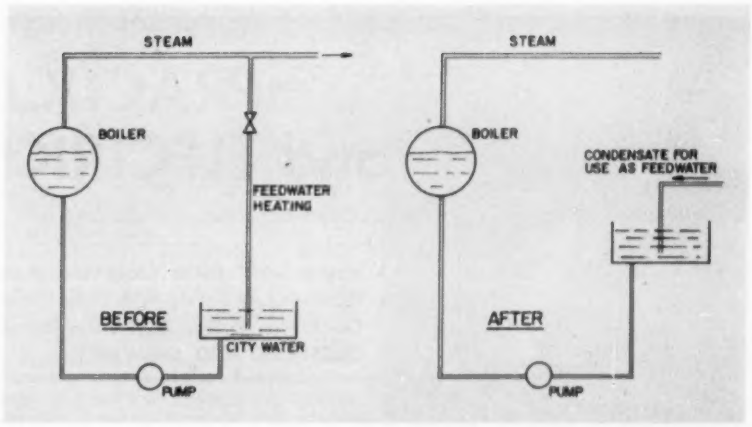


Fig. 2. If receiver tank is too close to pump suction inlet, as shown at left, preheat temp of boiler feed water is limited by flashing occurring at suction. Solution is to raise tank as shown at right of this sketch

of thermal protection. Later, it was noticed that the motor was smoking, but before the operator got around to taking the compressor off the line, several coils had been so badly damaged that a complete overhaul of the motor was necessitated and three days were lost in the use of the equipment. During this time, the large compressor was operated at two to five pounds suction pressure to protect the freezer storage and hold the other rooms within safe temperature limits.

After this experience, the management purchased a 20 hp stand-by motor and starter.

Gage Glass Precaution

A gage glass is a very necessary part of a liquid receiver, regardless of the refrigerant used. Automatic shut-off valves at the top and bottom of the gage glass will prevent the escape of refrigerant in case the glass is broken. However, leaks sometimes occur in the connections between the receiver shell and the automatic valves and they cannot be repaired without first pumping all liquid from the receiver. This is generally a time-consuming operation which calls for a complete shut-down of the plant, unless a spare receiver is connected to the system to be cut in if needed.

Where a large receiver is involved, it is often difficult to find sufficient storage space for the drawn-off liquid. The solution is to place an angle valve on the gage glass connection at the top and bottom of the receiver (shown in Fig. 2). It becomes a simple matter, then, to close these valves in case of a leak in the small pipe connections between the receiver and the gage glass and repairs can be made without pumping out the receiver or shutting down the plant.

The two valves, one at the top and the other at the bottom of the gage glass, are the ones normally provided by the manufacturer. These valves have ball seats and when a glass breaks, the metal balls are carried forward until they seat and prevent escape of ammonia or Freon, as the case may be. However, it sometimes happens that the piping connection at the receiver on these automatic valves develop trouble.

Double Protection

Because of this, I began many years ago the practice of placing angle valves at the top and the bottom of the receiver shell. These valves can be closed in case of trouble at the connections and, what is equally important, when installing a new glass. With these valves closed, there is no danger of having full pressure against the automatic valves during the changing operation.

If the receiver were located in the basement of a building, for example, and a glass broke, with no way of stopping the flow of liquid refrigerant either manually or automatically, things would be mighty bad.

Why should this apply to gage glass piping only and not to all piping? As a matter of information, a valve is placed on the liquid inlet of a receiver and also on the liquid outlet; dual safety valves are used on liquid receivers. These are ASRE valves so designed that in case one valve leaks, from any cause, the two-way valve is closed, cutting out the leaky valve and immediately putting the second valve in communication with the receiver. In other words, it is impossible to shut off both valves at the same time.

Ignorance or Dollars?

Within the past three or four years, I have investigated four cases of compressor trouble that the owners were anxious to have cleared up. Two were ammonia compressors used in refrigerating plants and the others were compressors for Freon 12 comfort cooling plants.

In each instance trouble occurred as the compressors were automatically started by the thermostatic control when the temperature called for compressor operation. It required 30 to 40 minutes, following the start of the machine, for the compressor to settle down to quiet operation which continued without vibration until the compressor was stopped by the thermostat. Investigation in each case obtained the same answer — when starting, the compressor cylinders were flooded with liquid from the evaporator. The question was: Why was the evaporator full of liquid? And the answer proved to be that the contractor who had installed the equipment was either ignorant of cause and effect, or a money-grubber who had no scruples about chiseling. No solenoid valve had been placed on the liquid line to stop the flow of liquid refrigerant to the evaporator when the compressor stopped.

Who Was to Blame?

The installation of a solenoid valve on the liquid line, to open and close with the starting and stopping of the compressor, was the solution to the trouble in all of the cases involved.

Question: Who paid for the investigation and subsequent installation of the control valve?

Answer: The owner.

Question: Why did the owner have to pay such a bill?

Answer: Because the contractor had carefully explained that such a valve was not called for or specifically mentioned in the contract between the buyer and the seller.

Question: Are the buyers in these four cases satisfied?

Answer: Certainly not! — and they tell others how they were gypped.

In the case of one of the ammonia refrigerating plants, the discharge piping between the compressor and the condenser would frequently cool down to a point where the flanged joints would contract to such a degree that leaks would occur, resulting in the loss of refrigerant. If ignorance prevents a contractor from installing a solenoid valve on a liquid line, then he should try some other means of livelihood; if the almighty dollar prompts such practice, then he should be in jail.

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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How to Drill Precision Cross-Holes in Shafts

By F. E. RILEY

PIN HOLES drilled diametrically through a shaft are among the simplest machine part assembly methods and are also one of the quickest to carry out with simple workshop equipment, such as is likely to be available to the power engineer engaged on maintenance work. A sensitive drill press and a machine vise are usually all that is needed in the way of equipment to do the job.

Unfortunately, the positioning of the drill over the true vertical diametral line of the shaft is one of these hit-and-miss processes which lead to endless trouble. If the hole wanders off the true vertical diameter, the deviation is usually glaringly apparent to the naked eye. Yet if the judgement of the eye is relied on for placing the drill, in the first place, the resulting hole is rarely central. Improved procedures and some simple auxiliary tools will help to produce holes which intersect the vertical diametral line perfectly and a few successful applications of these are described.

There are two variable factors in the placing of a hole centrally in a round shaft; these are the shaft diameter and the hole diameter. Nothing can be done about the shaft diameter, but the hole diameter can be encouraged to conform to standardization by always drilling a starting dimple or depression with one size of combination center drill. This drill is strong, short in length and is, therefore, less likely to wander. The small-diameter pilot fits neatly into a center-punch mark and can be encouraged to follow it closely.

The simplest way of placing a center punch depression at the highest point on the perimeter of a round shaft is illustrated in Fig. 1. The shaft is coated with marking fluid and gripped in the machine vise. By using a pair of hermaphrodite calipers in the manner illustrated, it is possible to scribe a pair of closely spaced lines, the central portion denoting the high point of the bar surface. It will be noted from Fig. 1 that one of the caliper legs can be adjusted for length so that the scribing point can be presented to the work surface in the most accurate manner. The bent end of the other leg bears on both vise jaw and work surface and is thus placed accurately.

A center punch mark carefully placed between the scribed lines will start the center drill accurately and will give the following twist drill a good start. The accuracy of this method is dependent to a great extent upon good eyesight and precise placing of the punch mark. The work should not be shifted in the vise before the hole is drilled.

For really precise placing of a cross hole, the method illustrated in Fig. 2 is hard to beat. This method requires the use of a little jig which consists of a circular metal disk turned in the lathe with two external diameters and a bored central hole. The hole is a close running fit for the body of a standard center drill and the small outside diameter is equal to the diameter of the shaft to be drilled, less about 0.002 in.

With the work gripped in the machine vise, the jig is placed in the tops of the jaws where it will fit neatly without much slack. Slack can be taken up by altering the pressure of the vise jaws on the work. The center drill is fed downward, through the guide hole in the disc and into the work. It is an easy matter to remove the disk from the grip of the vise and

Fig. 1. Locating the high point or top center of shaft with marking fluid, hermaphrodite calipers

Fig. 2. Precision drilling is best performed with the guide disk; small diameter equals shaft size

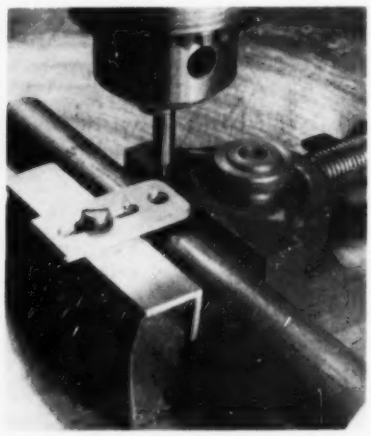


Fig. 3. Simple, adjustable jig made of machined angle iron can be accurate to approx. 0.005 inch

to complete the hole through the bar with the correct size of twist drill fed straight down.

Guide disks need not be hardened as they are not likely to wear very much with only occasional use. They are easily made and can be used for any desired hole size if the same size of center drill is used for starting all holes. With the form illustrated, it is necessary that a disk be made for each bar diameter, but it can be seen from Fig. 2 that one disk could have three different diameters for three different bar sizes; one smaller diameter on each side of the central big diameter which, itself, can be used for drill guiding.

A simple jig which gives accurate results on almost any diameter of bar which the vise will accommodate is illustrated in Fig. 3. It comprises a length of angle iron machined all over so that one leg of the iron is about the same depth as the fixed vise jaw. The one illustrated was made for use on another vise which was not available when the photograph was taken.

The horizontal leg of the angle iron lies on top of the fixed vise jaw and is drilled and tapped to take a locking screw which holds an adjustable arm having a center drill guide hole at one end. The elongated slot in the arm, through which the screw passes, allows the arm overhang to be adjusted; the overhang from the guide hole center to the vertical face of the angle is equal to the radius of the bar to be cross-drilled.

On the underside of the arm, a line is accurately scribed to intersect the guide hole center so that a rule can be used to set the amount of overhang. One end of the rule butts squarely against the face of the angle iron and the desired bar radius is denoted by the distance of the hole center line along it. With care, the radius can be set accurately to about 0.005 in. It depends how closely the operator can work to rule calibrations and a magnifying glass is an aid to accuracy.

Drilling of the center hole is accomplished easily as indicated in Fig. 3 and when it is completed, the arm is swung out of the way by loosening the screw and the correct size of drill is mounted in the chuck and the final hole drilled. The vise is not loosened until the finished hole is drilled.

Versions which are more elaborate than the jig in Fig. 3 have been evolved. For example, the arm is made to slide horizontally between guide pins so that it is always at a right angle to the angle-iron base piece. A further requirement is to drill and tap several holes along the length of the angle iron top surface so that the drill guide hole can be adjusted for the most convenient position along the work length. In jigs having rigid guides for the overarm, provision has to be made for lifting off the arm completely or for sliding it for a long distance so that the finishing drill can be used.

It is often necessary to drill a pair of cross holes at right angles to one another in the same shaft and the gadget shown in Fig. 4 allows this to be accomplished easily. The device is a pin surmounted by a large-diameter head fitting neatly in the existing drilled hole. The pin head is faced off square in the lathe to the axis of the small diameter part fitting in the cross hole. The face abuts against the vertical face of the fixed vise jaw and automatically positions the existing hole horizontally.

It will be noted, in Fig. 4, that some packing is needed between the shaft and the vise jaw to hold its axis parallel thereto; therefore, it is advisable to machine the head of the pin to an exact standard thickness. In the example illustrated, the pin head is exactly $\frac{1}{4}$ in. thick so that a piece of standard $\frac{1}{4}$-in. packing can be used further along the vise jaw. It will also be noted in Fig. 4 that the pin head is hexagonal. This is because it was made from an old $\frac{3}{8}$-in. bolt. It is quicker and easier to make such pins from scrap bolts by turning off the threaded portion to fit in the existing cross hole in a shaft.

Sometimes it is necessary to drill the second cross hole a long distance away from the first one. This causes the first hole to be placed right out of the vise jaws. The headed pin can still be used for placing the first hole at a right angle to the new one by applying a square to its surface, as shown in Fig. 5. By this method, it is possible to place the new hole at any desired angle to the existing hole by substituting a protractor for the square.

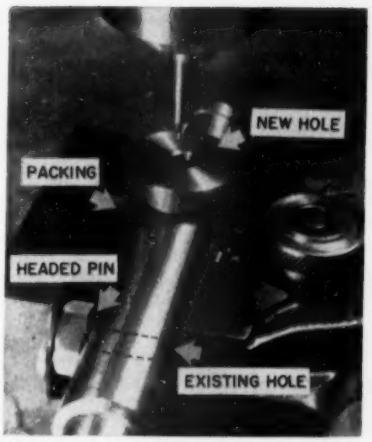


Fig. 4. Drilling cross-holes at right angles can be done by fitting machined, flat-headed pin into original hole and clamping head against vise jaw

Fig. 5. When headed pin in Fig. 4 falls beyond a vise jaw, substitute a square and place it against head. Use a protractor in place of the square to set second hole at angles other than 90 degrees

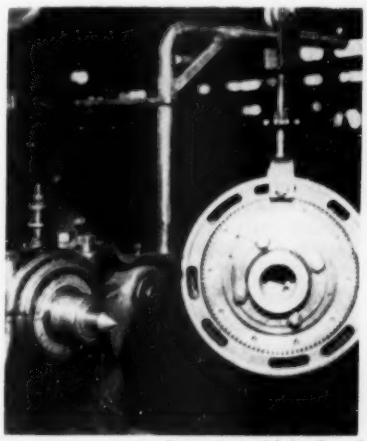
Handle Chuck Safely With Lathe Crane

MOUNTING a chuck on a lathe is not a complicated job, but it is difficult to do by hand. The chuck is heavy and cumbersome to handle, and too often it is the cause of personal injuries to the lathe operator.

To eliminate the need for lifting the chuck and holding it out over the lathe bed while mounting it, one shop devised a simple lathe-mounted crane to do the job. It can also be used for out-of-the-way storage of the chuck while keeping it handy for use.

The photo shows the elements of the crane and its use in mounting the chuck. A roller such as those used in supporting horizontal pipe runs can be obtained in a size to fit the pipe constituting the crane arm; this, with the swing of the crane, provides horizontal adjustment. Vertical adjustment need not be large and is provided by the clevis, handwheel and adjusting screw, which doubles as the chuck support. The lower clevis is secured to the chuck with a through-bolt.

A single cap screw mounted in the end of the horizontal pipe (crane arm) prevents overrun of the roller and dropping the chuck.



Photos: National Safety Council

When lathe chuck is not in use, it is swung out of the way on the side opposite to the operator

Quick Way to Stop Float Valve Hammer

By ANTHONY GREER

SOME TIME ago, we had considerable trouble with our institution's cold water supply system. We have an 11,000-gallon suction tank receiving water from two 60- to 80-psi sources. One 4-in. feeder enters from the north side of the building and another 4-in. feeder enters from the south side. A check valve and meter are on each service, and both services are tied into a common supply for the house suction tank.

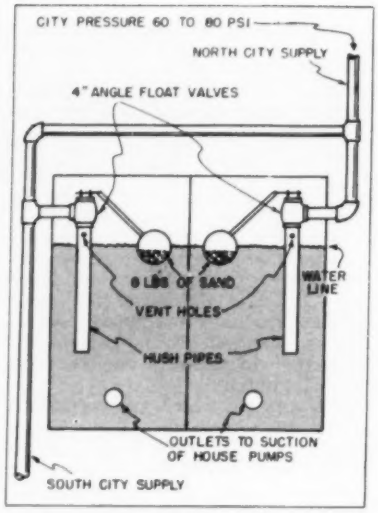
This suction tank is a two-compartment tank with a 4-in. angle float valve supplying each compartment. Each compartment can be operated separately so that repairs or cleaning can be made on either unit.

One day we noticed a heavy water hammer at the float valves. This caused the 4-in. lines to vibrate so badly that several leaks developed at the fittings on the feed lines. Looking inside the tank, we found the floats bobbing up and down, alternately causing partial opening and full closing of both valves, which caused the water hammer. We throttled the gate valves on each feeder, the floats became steady, and we thought the problem was solved.

Several days later there was a terrific noise from the tank room. Before any of the maintenance crew could reach the top of the tank and shut off the gate valves, the two meters were wrecked, the two float valves were wrecked, and more leaks had developed along the feed lines. When we removed the float valves they were so badly buckled that we had to machine new valves.

Surface turbulence was being caused, we felt, by the heavy flow through the 4-in. valves at 80 psi. It, in turn, was causing the snap action of the float valves. To correct this, we drilled holes in the floats and loaded them with sand until they were about two-thirds submerged at high water level (see illustration). This dampened response of the floats to surges at the water surface.

Though the most logical way to prevent a recurrence of our trouble was to install air chambers at the float valves, we could not tolerate a long shutdown since several hundred patients' well-being was at stake. Instead, we installed hush-pipes in the 4-in. valves' outlets and extended them to within 3 ft of the bottom of the tank. These pipes were drilled between the valve and the high water mark, four $\frac{3}{8}$-in. holes to the pipe, to allow the escape of entrained air and to provide cushioned valve action.



Two-compartment, 11,000-gallon house suction tank after corrections to stop turbulence and hammer

Results of the two alterations are (1) less surface turbulence, and (2) no more valve hammer. The installation was made over a year ago and we have had no trouble with the float valves since.

QUESTIONS AND ANSWERS

Answer to No. 518

What Is Heat Loss from Cypress Water Tanks?

Less Than Most Woods But Poorer Than Insulations—Fitzpatrick

CYPRESS wood has a lower thermal conductivity than other construction woods; however, it does not closely compare with commercial insulations.

Bureau of Standards Letter Circular No. 227, lists the following data:

Material	D	k
Cypress	29	0.67
White Pine	32	0.78
Virginia Pine	34	0.98
Balsa Wood	7.3	0.33
Oak	38	1.02
Maple	44	1.10
Concrete		6 to 9
Masonite		0.33
Fiberglas		0.25
85% Magnesia		0.45
Mineral Wool		0.45
Molded Asbestos		0.39

where D = density in lb per cu ft, and k = thermal conductivity in Btu per hr per sq ft per in. thickness.

These figures are representative of production run checks by insulation manufacturers. Samples are tested on electrically heated pipes, providing heat loss measurements accurate within 1 per cent.

Bare outdoor tanks will give 40 to 110 per cent loss with wind velocity of 10 mph. With 30 mph wind, surface loss is 15 per cent for 1-in. insulation, 10 per cent for 2-in., and about 5 per cent for 3-in.

Every insulation installation more than 5 years old should be checked against the current maximum vs cost ratio. Higher fuel costs in a number of cases have shown an increase in economical insulation thickness.

Insulation covering outdoor tanks should be tightly sealed and a weatherproof jacket well-lapped. Ordinary paint should not be used since it soaks into insulation and reduces its effectiveness. Synthetic compounds such as glyptals have been used successfully and they provide a smooth, tough coating that withstands heat and moisture.

L. W. FITZPATRICK
Jefferson City, Mo.

Answer to No. 519

How Can He Prevent Corrosion In This Steel Stack?

Coatings Must Be Repeated—Warren

IT HAS been a long time since I have burned hogged or wood fuel, but as I recall we were able to obtain approximately 13.5 per cent CO_2 with a moisture content of about 45 per cent in the wood. The wood (dry) had a carbon content of about 82 per cent. I do not recall the exact O or CO. We know, however, that it requires approximately 6.0 to 6.5 lb air to burn wood.

Evaporating the salt water with which the fuel has been wetted will leave the salt which, when burned, makes chlorine gas which leads to corrosion of steel. There are products on the market to brush on, spray on and even burn on that would extend the life of the stack. These materials have a limited life and W. A. might not have sufficient outage time to permit re-coating at regular intervals.

Metal alloys can be had to do this job, but the economics could not justify this approach in most industries. Stacks made of concrete, vitrified or acidproof products are best.

Keep stacks dry, reduce moisture in the fuel (eliminate salt water wetting of the fuel if possible), and reduce excess air used in burning the fuel to slow down corrosion.

Freeport, Tex. J. P. WARREN

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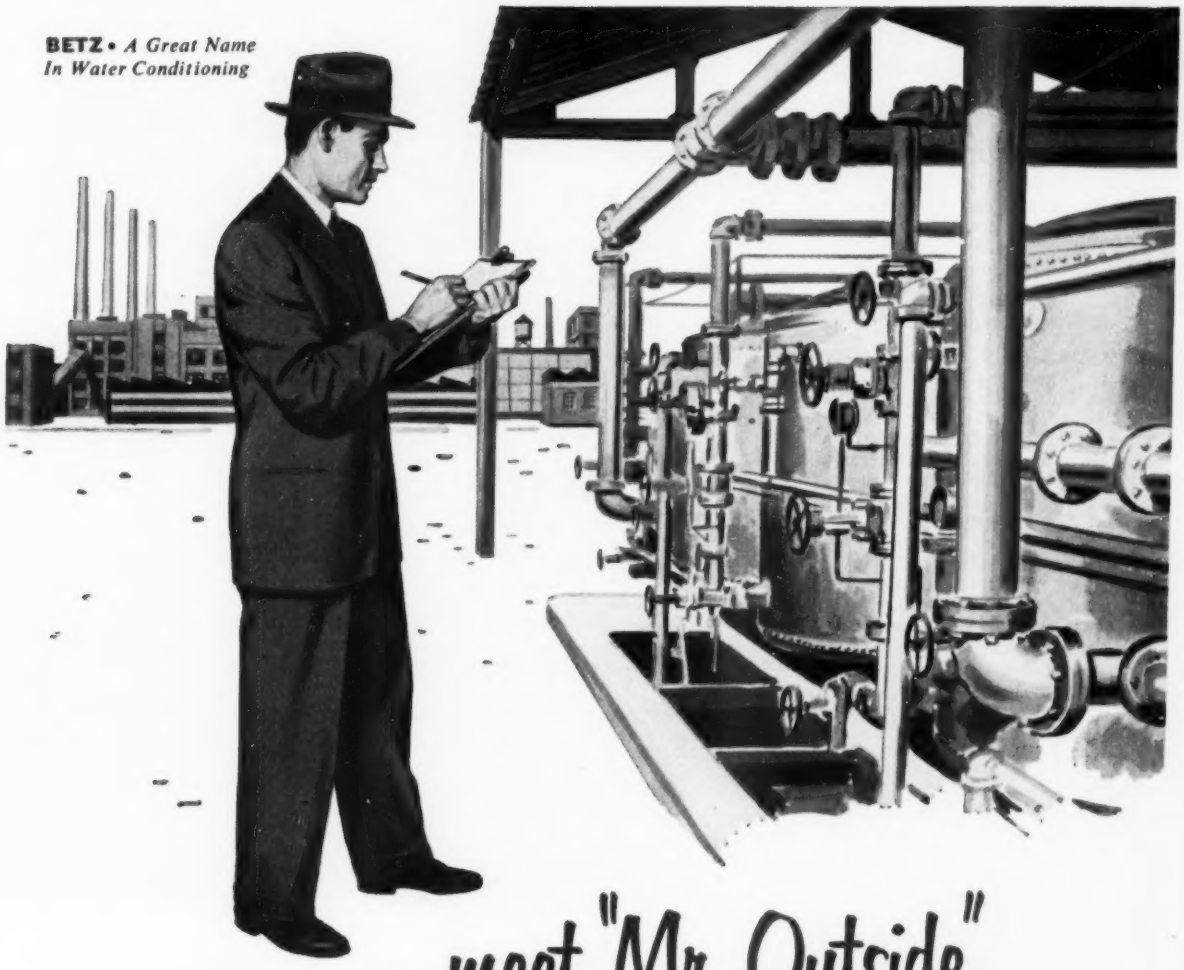

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CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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Answer to No. 521

Can You Calculate Water Flow Through Funnel?

Here's How, Says Burton

FLOW OF WATER or other liquids through a funnel can be calculated in the following manner:

From a basic law of hydrodynamics, the total head (H) must always be equal to the velocity head $\frac{V^2}{2g}$ plus the friction head h_f (assuming the upper surface of the liquid to have a negligible velocity).

If, for the present, we neglect friction, the height of the funnel (h) can be found by first finding the total head, H, and subtracting the height of the tailpipe. For the purpose of finding the height for various rates of flow and discharge diameters, I have prepared the chart in Fig. 1. This gives theoretical values, and similar figures can be found in handbooks such as *Cameron's Hydraulic Data*. This chart may also be used to find the rate of discharge of tanks if the outlet diameter and the height of the surface above the outlet are known.

To find the actual height, we must add to the theoretical head the friction head, h_f. This friction head will consist of viscosity losses in the funnel, entrance (into the tailpipe) losses, and friction in the tailpipe.

For water, it will be shown, the viscosity losses are negligible. According to *Marks' Mechanical Engineers' Handbook*, the entrance loss into a smoothly tapered pipe is about 2 per cent, and into a slightly rounded entrance it runs about 10 per cent. Values for the friction head in the tailpipe can be found in such books as *Cameron's Hydraulic Data*. Thus, the actual height would be theoretical H plus 10 per cent plus the friction head in the tailpipe.

For viscosity losses, I have derived an equation and plotted the results shown in Fig. 2. The curves shown are for water at 60 F, which has a kinematic viscosity of 12×10^{-6} sq ft per sec. Since the head losses are directly proportional to the viscosity, multiplying the head obtained from the chart by the ratio of viscosity of some other liquid to that of water gives the corrected head. Here are some typical and frequently-used correction factors:

Brine	1.8
Kerosene	2.25
No. 3 Fuel Oil	10.0
Turbine Lube Oil	125.0

Excellent tables of viscosities may be found in *Tube Turns Technical Piping File 3.01*, Crocker's *Piping Handbook*, and in *Marks' Mechanical Engineers' Handbook*.

Figure 2 was constructed with values obtained from the equation:

$$h_f = \frac{13.6\ v'\ Q}{g\ m}\left[\frac{1}{D_1^3} - \frac{1}{D_2^3}\right] \text{ ft}$$

In this equation, v' = kinematic viscosity in sq ft per sec, Q = flow in cu ft per sec, g = 32.2 ft per sec per sec, m = slope of funnel in ft change in diameter per ft length, D_1 = diameter of funnel outlet in ft, and D_2 = diameter of funnel top in ft.

Since D_2 will be very large with relation to D_1 in a funnel, it is justifiable to neglect the factor $\frac{1}{D_2^3}$. In the chart calculations, m was taken as $\frac{1}{4}$, and Q was converted to gpm, which resulted in a working equation:

$$h_f = \frac{0.00285(v')\ (\text{gpm})}{D_1^5} \text{ ft}$$

Example: Assume that we want to find the height of a funnel that is to handle 100 gpm of water, having a tailpipe 1½ in. in diameter and 5 ft long.

From Fig. 1, theoretical H	= 5.60 ft
Plus 10 percent entrance loss	0.56 ft
Plus pipe friction	5.25 ft
From Fig. 2, funnel loss (negligible in this case)	= 0.02 in.
Total required head	= 11.41 ft
Less tailpipe	− 5.00 ft
Height of funnel or about 6 ft 6 in.	= 6.41 ft

I sincerely hope that this will help solve the funnel problem outlined in Question No. 521.

Brookfield, Ill. J. F. BURTON

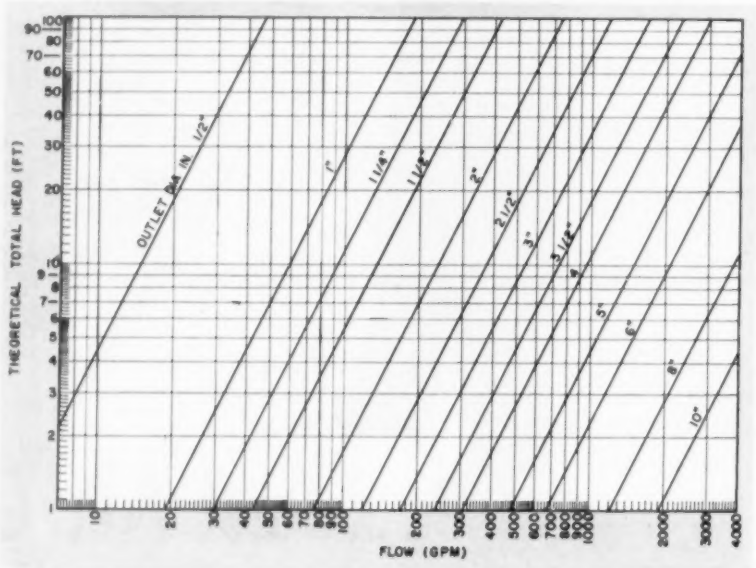


Fig. 1. Chart for the determination of total theoretical head, H, from flow and pipe diameter data

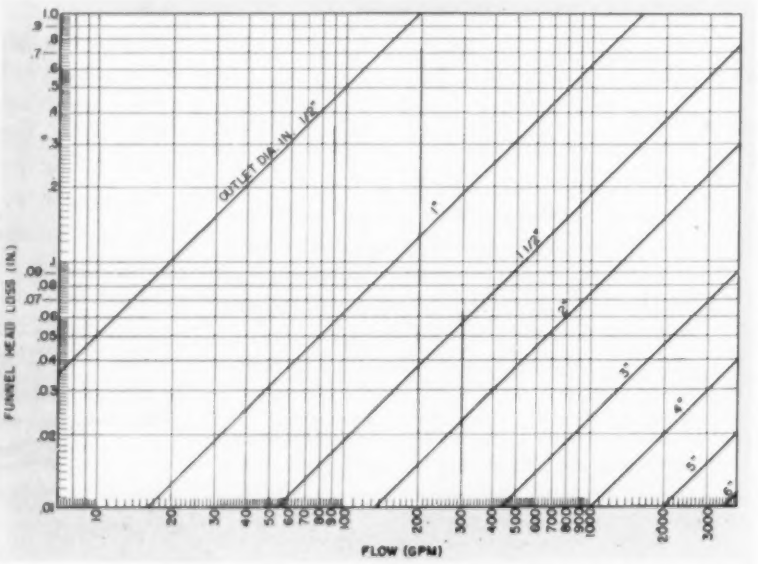
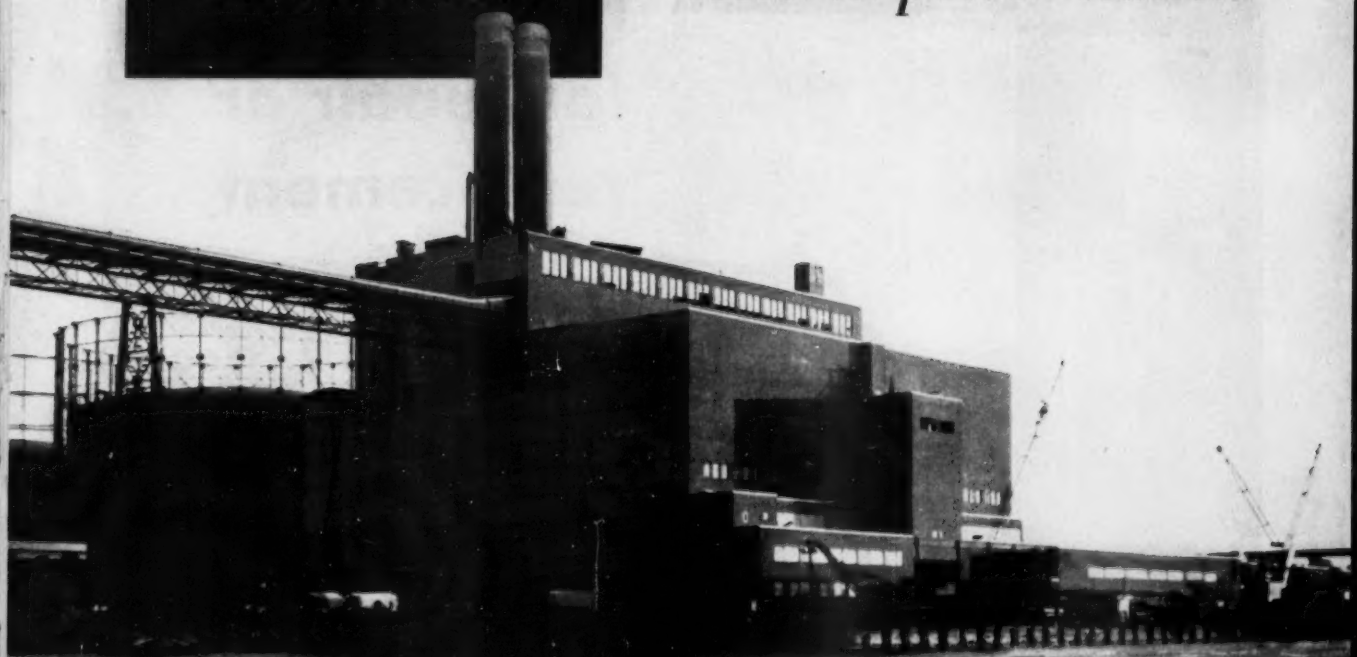


Fig. 2. Chart for the determination of viscosity losses in a funnel, calculated here for water at 60 F

DE LAVAL

BARREL TYPE
BOILER FEED PUMP

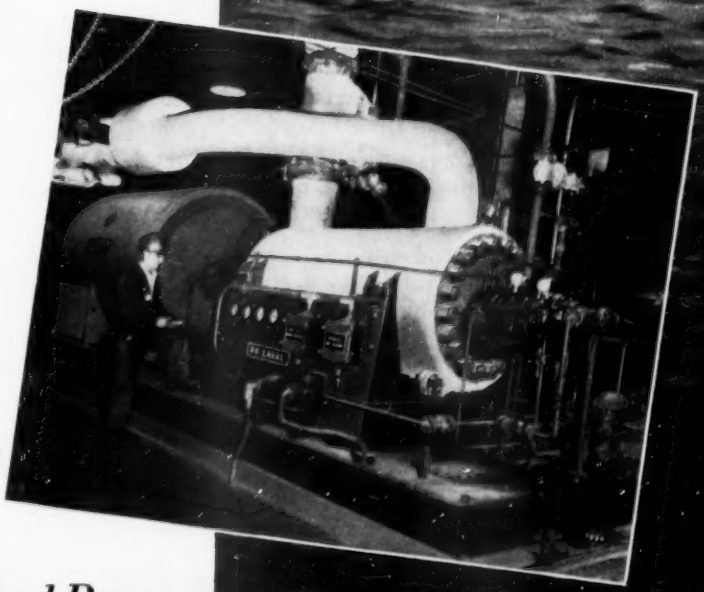
in new **Con Edison**
Astoria power station



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.

The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches.

De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.



DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
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DL 288

Not a cent for repair or replacement

. . . of Monel parts in more than 27 years!

Continuous Performance. Installed by the Potomac Edison Company in 1927, this Chapman valve has stem, seat and disc rings of long-lasting Monel. Not a single one of these Monel parts has ever given trouble, and the valve itself is still in perfect operating condition.

Let's *all* take a careful look at this valve.

It's a 16-inch motor-operated Chapman. You'll find it on the No. 3 unit main steam header at the R. Paul Smith Station of the Potomac Edison Company, in Williamsport, Md.

When it was installed in 1927, no one was sure exactly how long its Monel® stem, Monel seat and Monel disc rings might last.

And no one knows, even *today*. This Chapman valve—now well past the quarter-century mark—is still in operation, still working perfectly. Despite more than 27 years of service at 350 W.S.P. and 700°F., not a single Monel part has ever needed a penny's worth of repair!

Remember this performance next time you need valves: Specify Monel trim and you insure yourself against frequent repair bills and costly maintenance expense.

In Monel, you have a metal that is stronger than structural steel, and harder than most non-ferrous metals. This, of course, helps reduce failures caused by overstressing seats, stems and other working parts.

Because of its hardness, Monel can substantially reduce damage caused by turbulence, flow erosion and particle abrasion. Being rustproof and corrosion-resisting, Monel can greatly extend the life of valves operated under severely corrosive conditions. And its good heat-resisting qualities permit the use of Monel in service up to 750°F.

Leading valve manufacturers stock Monel-trimmed valves for all power plant applications. Ask about these valves. They're designed to give you extra long life with a minimum of maintenance. And write us for a helpful booklet that shows how you can save money on valves used for many kinds of difficult service. Just ask for a copy of "Trimming Valve Costs with Lasting Trim."

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A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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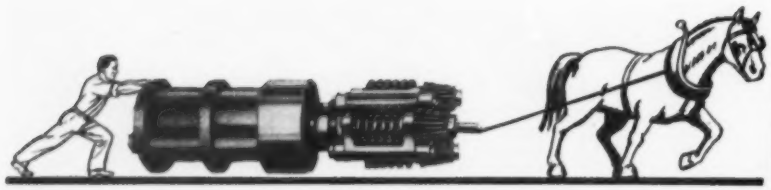

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Letters to the Editors

continued from page 6

having one man on each side of the fence. The pan for this purpose is similar to that of a baking tray, and a wiping rod or wire is stretched across one end of the pan. Paint is put into the pan about an inch or two deep and the brooms are dipped into this paint and then the excess is wiped off on the wiping rod so that the broom is used with a very dry paint content. The brush strokes then go with the mesh of the fence. After the mesh is painted, the long handles are unscrewed from the brooms and the same brooms can be used for painting the pipes and other supports. Reports indicate that a two-man crew can paint 200 to 500 lineal feet of six-foot-high fence daily including posts and barbed wire.

With either method, a single gallon of paint covers approximately 30 lineal feet of six-foot-high fence complete. A heavy lead suboxide pigment blended with aluminum is recommended for this purpose. The heavy lead suboxide prevents spattering and flickering during application and serves as an excellent medium for rust-inhibition. The aluminum content of the paint gives an appearance very similar to that of weathered galvanizing so that only a single coat is used and the fence is restored to its original appearance. Such single-coat painting has been found to give from five to eight years life when applied by either roller or broom method — *T. J. Eberhardt, Hackensack, N. J.*

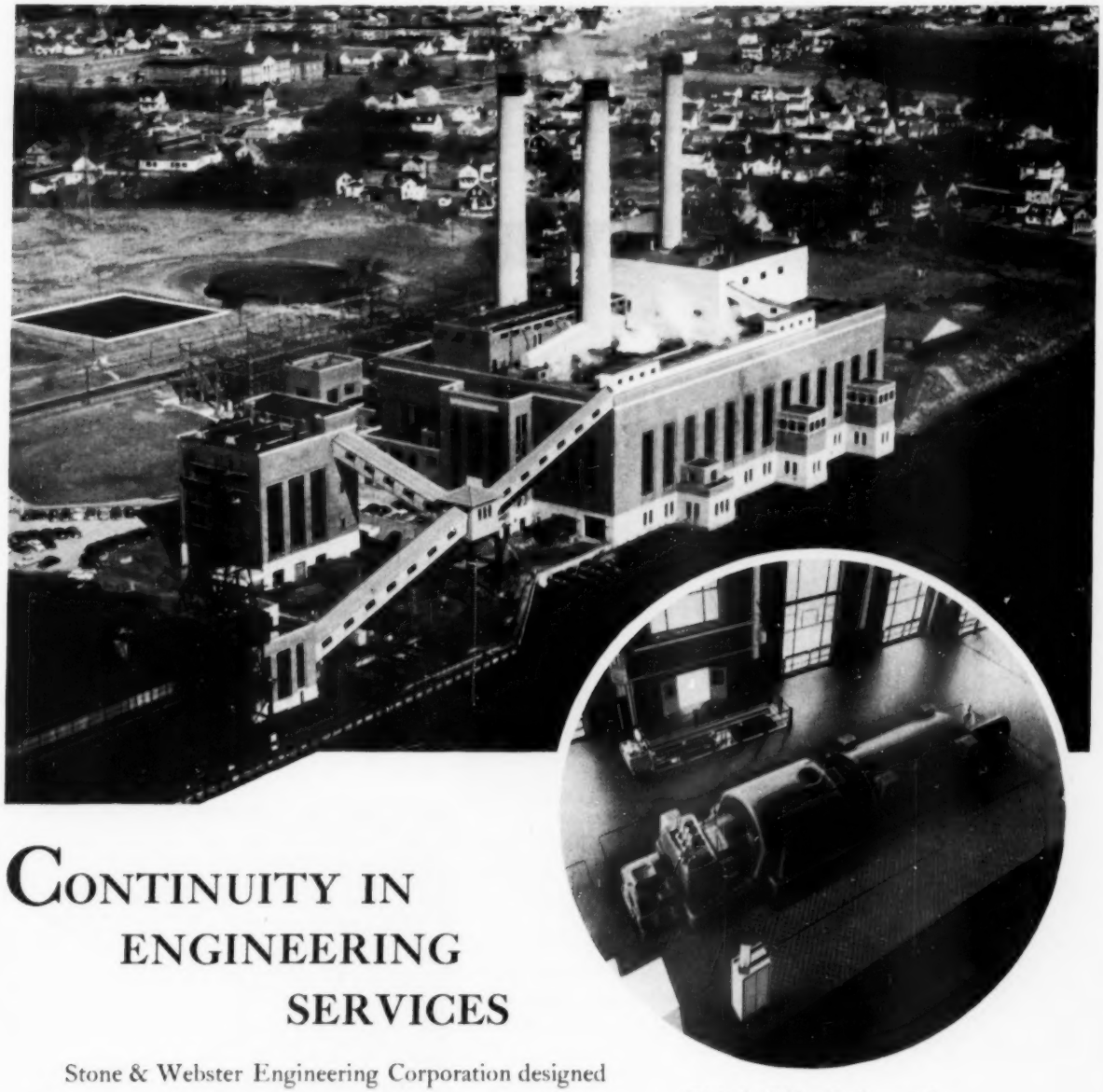
Zinc Powders

USE OF zinc powders in protective coatings to resist galvanic corrosion has been increasing. A number of paints with percentages of zinc up to 93 per cent are on the market, as referred to in my article on corrosion, page 82, December 1953 issue.

These high-zinc-content paints serve as a type of galvanizing or electro-deposited zinc coating, and are said to function quite well. The protection provided by this new paint is based on electro-chemical action. Corrosion attacks the zinc layer, leaving the steel untouched. Corrosion breaks the zinc down into a firmly adherent film of zinc hydroxide (or calcium carbonate in salt water), and this film in turn offers further anti-rust protection both to the zinc and the steel, and slows down additional breakdown of the zinc.

I have used an addition of 2 lbs of metallic zinc powder per gallon of red lead as a standard ground coat on steel. I have found this mixture an improvement on the straight red lead without the added zinc insofar as resistance to corrosion on steel surfaces is concerned. I have procured this red-

continued on page 115



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Stone & Webster Engineering Corporation designed and constructed the first unit of Somerset Station for Montaup Electric Company at Somerset, Massachusetts in 1924. Three years later the Engineering Corporation designed and built a second unit; in 1942 the first large high pressure controlled circulation boiler in this country and a third unit were installed; in 1947 a fourth unit was added and a fifth unit is now on the line.

Four-fifths of all the construction work of the Corporation amounting to well in excess of three billion dollars has been in the form of "repeat orders" from clients.

With the fifth unit shown above, Somerset Station has a net capability of 210,000 kilowatts

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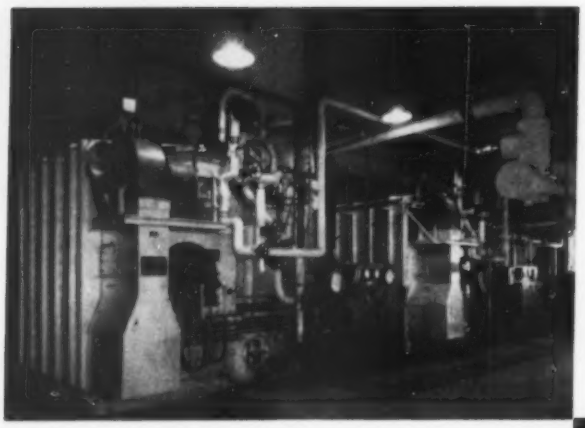
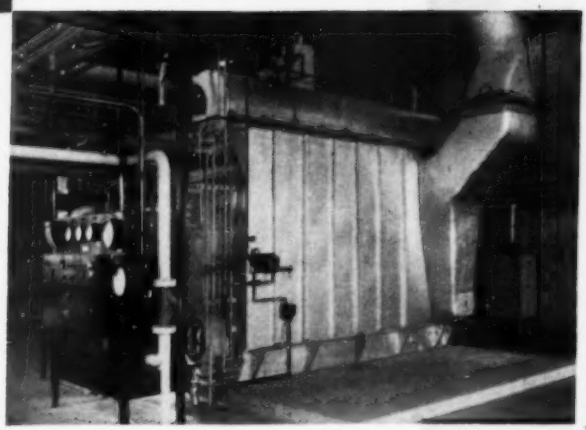
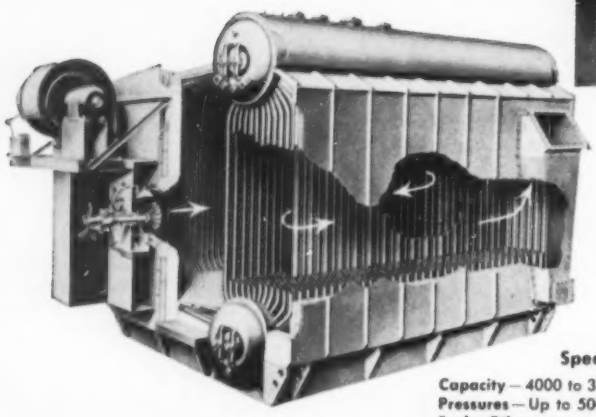
WHY ARE THEY



Industrial installation in the Midwest. Two VP Boilers. Capacity — 28,000 lb steam per hr each at 225 psi.



This VP Boiler serves a sewer pipe manufacturer in California. Capacity — 20,000 lb steam per hr at 215 psi.



Specifications — VP Boiler

Capacity — 4000 to 30,000 pounds of steam per hour
Pressures — Up to 500 pounds per square inch
Fuel — Oil or gas
Erection — Completely shop-assembled
Foundation — Simple concrete slab

BUYING VP Boilers?

There's good reason for the fact that so many buyers of package boilers are finding that the VP offers them more for their money. For only in the VP will you find such significant *extra* features as—more water-cooling area per unit of furnace volume than any other boiler of its class . . . simple arrangement of baffles for maximum heat transfer . . . large lower drum for good accessibility and easy handling of load swings . . . quiet centrifugal fan, with less than half the noise level of typical high-speed blowers used on most other package boilers.

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No other mechanical recovery equipment has so many years of fly ash recovery experience behind it . . . or has such uniformly high collecting efficiency . . . or provides so many other money-saving, space-saving advantages as MULTICLONE. The four advantages outlined below are by no means the complete MULTICLONE story, but are typical of the vital savings found *exclusively* in MULTICLONE equipment . . .

In fly ash recovery

MULTICLONE COLLECTORS

***and only Multiclones* give vital advantages like these . . .**

Uniformly High Recovery:

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Long and narrow

Square

Maximum Adaptability:

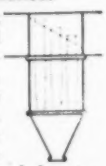
In addition to its unusual compactness, the MULTICLONE is also unusually adaptable to various installation requirements. Where head room is low it can be installed with side-inlet side-outlet connections. Where side clearances are restricted, it can be installed with side-inlet top-outlet connections. In addition, without changing capacities, the shape of the unit can be varied—long and narrow, short and wide, or square—to fit restricted spaces . . . and its single-inlet single-outlet duct requirements permit greater flexibility and simpler installation. These savings slice installation costs, space requirements and insulating expense.

Space-Saving Compactness:

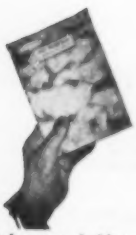
Plant space costs money—so be sure to check space requirements carefully. As shown in the accompanying chart, the MULTICLONE requires less floor space and less cubic space than any other unit of comparable capacity and performance. Translate these savings into today's high costs for plant space and you readily see the great importance of this one MULTICLONE advantage alone!

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

Minimum Maintenance:



The MULTICLONE has no high speed moving parts to repair or replace . . . no pads or filters to clean or renew . . . nothing to choke the gas flow or increase draft losses as suspended materials are recovered. MULTICLONE draft losses remain uniformly low *at all times*. Further, the recovered material from an entire bank of tubes is collected in a *single* hopper—far easier to service and maintain than the multiple hoppers of conventional cyclone units.



FREE INFORMATIVE BOOKLET
This 32 page booklet outlines the basic principles of centrifugal dust recovery and shows the many ways MULTICLONE advantages assure higher recovery at lower overall costs. A free copy of this booklet will gladly be sent on request. Write today!

Before you decide on any recovery equipment be sure to get complete information on MULTICLONE advantages. A letter, wire or phone call to our nearest office places this information in your hands without obligation. Get all the facts and you will get MULTICLONE Collectors!

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DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

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Letters to the Editors

continued from page 110

lead zinc paint in double compartment cans. The zinc was kept separate from the oils in order to avoid chemical action and the generation of gases which might explode the cans. At the same time, care must be used in the selection of the vehicle so that the paint will not deteriorate chemically after application. The mixing of zinc dust in the paint just when applied has always given us satisfactory results.

Now these products can be purchased already mixed, and it seems as though this type of coating is becoming more popular around power plants where heavy galvanic corrosion may be encountered — *L. G. Jones, Dayton, Ohio.*

Natural Gas Irrigation

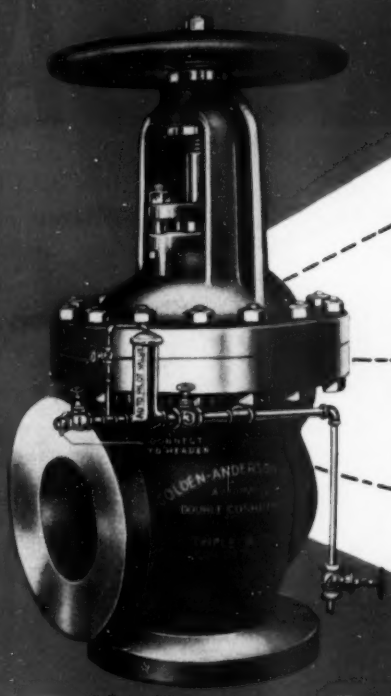
Editor's Note: the magazine *Business Week*, February 27, 1954 issue, carried a short item about a unique idea evolved by the Kansas-Nebraska Natural Gas Co. to encourage the use of natural gas power for summer irrigation of farm land. This move was designed to bolster summer consumption of fuel gas in an area which has practically no heavy industrial users operating on the familiar "dump gas" set-up. The farmers took to the idea wholeheartedly and began planning additional distribution pipelines of their own to tie into the company's lines. Smaller pipe and higher pressures were decided on as the most economical means of extending the new service rurally. When we wrote to Mr. Sigel, division superintendent for the company, he replied as follows:

WE ARE TRYING to keep pipe sizes to 1¼ in. and 2 in. with a design pressure of 50 psig using Weymouth's equation. Some projects are of such size that some 3 in. pipe will be necessary in them. Design is always based on 50 psig inlet pressure although, for the irrigation season only, we may, at our option, increase this inlet pressure but never above 100 psig. All lines are welded steel.

We do not anticipate the need for additional compressor capacity due to this development since our summer loads do not make full use of existing facilities. We hope that this development will, in some measure, put these facilities to greater use, but our primary objective is the development of the area by irrigation which should go a long way toward stabilizing the farm economy in the agricultural area served by this company. This, of course, would benefit not only the area but the company as well.

Not generally known is the fact that this company has, for a number of years, *continued on page 118*

The *Only* Valve that can be tested for Operation Without Dismantling !



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Continual service since 1909 in Packing Industry Power Plant.

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Triple acting non-return VALVE

SIX Body Designs in sizes up to 36"

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automatic control systems
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is our business

The primary purposes of every installation of Hagan Automatic Combustion Control and Instrumentation are to save fuel, and to provide the indications and records which guide the operators in maintaining maximum efficiency.

Each component of a Hagan System is selected to perform a specific function accurately and dependably, and to coordinate smoothly with all other related components in the system.

Back of every system, irrespective of size, there are more than thirty-five years of experience in development, design and application of Automatic Combustion Control and Instrumentation. As a result, Hagan Systems are easy to install, easy to calibrate and easy to keep in topnotch operation.

These typical applications emphasize the versatility of Hagan equipment and Hagan methods:

- Automatic combustion control systems for boilers of any size and pressure, burning all types of fuels, singly or in multiple.
- Boiler drum water level control, with automatic correction available for such factors as boiler load and boiler water density.
- Automatic control of gas and air temperatures for air preheaters.
- Draft and pressure controls for a continuous range from high vacuum to 5000 psig.
- Superheated steam temperature control.
- Pressure and temperature controls for feedwater heaters.
- Recording, indicating and totalizing flows of liquids, vapors and gases. Interchangeable sensing elements are available for full scale differentials from 1" to 560" WC.
- Simultaneous records of two separate flows, measured in a single meter housing. Flows may be added or subtracted.
- Pressure and temperature compensated records of steam and gas flows.
- Density compensated records of liquid flow or level, or for gas flows.
- Pneumatic and electric signal transmitters.
- Flow ratio control for liquids and gases.

Our engineers will be glad to suggest the Automatic Control and Instrumentation to fit your requirements.

Hagan Corporation

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HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Automotive and Aeronautical Testing Facilities

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This True Ball Joint Makes the Difference

QUICK FACTS

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Letters to the Editors

continued from page 115

provided gas service to the rural customers along the lines, averaging about one such customer per mile of pipeline. This service is made available to farmers who build to the company lines, but it has only been since last October that we have entertained the building of distribution system for irrigation wells at some distance away from our mainlines. This phase is new and we are finding ever increasing interest in it.

Relative to gas-burning combustion turbines, we do not have such equipment, so do not feel that we are in a position to comment.

We are frequently asked about the feasibility of projects such as we are working on in other parts of the country. We do not know the answer excepting to state that the prime essentials are irrigable land over an ample underground water supply with natural gas supply at competitive rates compared to other fuels or power sources. In this respect, we are fortunate in much of the area we serve. It is only under such conditions that the investment made by farmers will readily pay out and therefore be feasible.

The article which you read in *Business Week* pretty much tells the balance of the story of what we are trying to do; and I am happy to report that considerable progress is being made. — *A. J. Sigel, Hastings, Neb.*

Concerning Harry Kuljian's Article –

THE FORCEFUL STATEMENTS about our dwindling basic resources, as noted in "A Look at the World's Energy Resources" (March issue, page 96), call our attention to the compelling need to develop, as soon as practicable, any source of energy available.

Hydro electric energy as a primary source being replaced on a seasonable or periodic basis, offers an encouraging possibility when developed in connection with wind power.

We have the development of the Wisconsin River water users, developing the resources through "pumped storage," all at private expense without federal control or public funds.

A member of the Federal Power Commission staff, Percy H. Thomas, made a study involving wind-powered generating units. While wind-powered units have been in use for many years in smaller capacities for battery charging and similar service, there seems no reason why such equipment cannot be developed in higher capacities.

There appeared some three years ago, an article about a 500 kw wind-powered *continued on page 121*

NEW "Small" boiler is a Big Quality package!

Available up to 80 hp — heating or processing — steam or hot water. A complete unit from a single source.

CLEAVER-BROOKS modern C-B boiler

NO BOILER HAS EVER OFFERED SO MANY ADVANTAGES AND QUALITY FEATURES AT SUCH LOW INITIAL COST

• This NEW CB boiler has EVERYTHING needed to bring *big boiler standards* to commercial, industrial and institutional users with small capacity requirements. Despite its unusual, compact size you get big boiler performance — from matched-quality components, proved the world over on thousands of Cleaver-Brooks self-contained units.

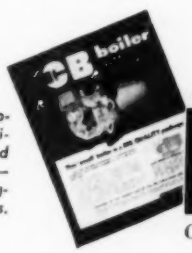
Get all the facts NOW on how the new CB can help you save dollars. Make it a point to see . . . and *hear* the most silent-running, biggest boiler value available anywhere!

•

gives you all the quality features of time-tested self-contained design

- **FOUR-PASS FIRETUBE CONSTRUCTION** — longer gas travel scrubs heat from flame — means lower fuel costs — guaranteed efficiency of 80% when firing with oil.
- **SILENT OPERATION** — even at peak load this boiler more than meets the low sound levels required for schools, hospitals, institutions.
- **FULL FIVE SQUARE FEET** — of heating surface per boiler hp — for longer service life and low maintenance.
- **FUEL FLEXIBILITY** — burns available light oil, gas, or combination oil/gas — simple, quick fuel changeover on oil/gas models.
- **FAST, EASY MAINTENANCE** — front and rear doors hinged for fast inspection, cleaning or servicing boiler.
- **AUTOMATIC SAFE OPERATION** — all controls centralized and conveniently located — modern electronic combustion control is standard equipment.
- **COOLER BOILER ROOM** — fiber glass blanket insulation and 16 gauge metal sectional lagging are non-corrosive, moisture and heat resistant.
- **FULLY APPROVED** — by Underwriter Laboratories; conforms to ASME codes; factory tested before shipment.

Call your nearest CB boiler representative (see your phone directory) or send for this illustrated catalog describing the NEW CB — designed by Cleaver-Brooks, originators of self-contained boilers.



Cleaver Brooks

Cleaver-Brooks Company, Dept. G, 311 E. Keefe Ave., Milwaukee 12, Wisconsin, U.S.A.
Cable Address: CLEBRO — Milwaukee — All Codes.

Originators of the Self-Contained Boiler

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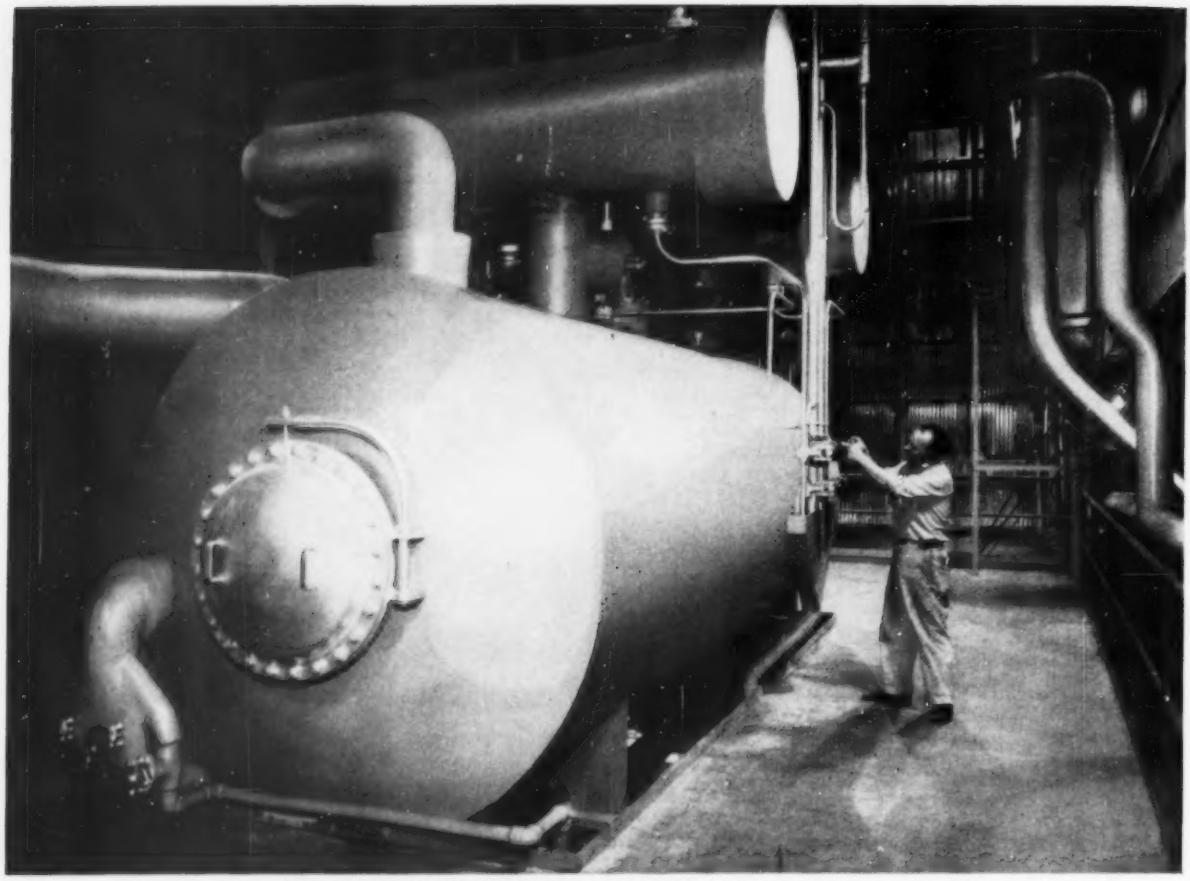

ONE OF SEVEN WORTHINGTON DEAERATORS installed by Stone and Webster Engineering Corporation, engineers and constructors for Virginia Electric's growing power system.

Now there are seven Worthington deaerators at Virginia Electric and Power Company

Back in 1939, the Virginia Electric and Power Company first started buying steam power equipment from Worthington.

Since that time, VEPCO has installed seven Worthington direct-contact deaerators in new or existing stations, the latest deaerator going to work in 1953.

There's a good reason for all this repeat business — *performance*. Worthington deaerators, like all Worthington steam power equipment, are built for service, built to keep going year after year under the most rigorous operating conditions. Features like easy tube accessibility, Worthington's patented tray system and specially designed distributing weirs add up to economical, dependable operation — with extremely low maintenance costs. Matter of fact, we think our deaerators are the best salesmen we have.

Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.4.1, Harrison, New Jersey. S.4.1

WORTHINGTON

A GREAT TEAM IN STEAM

Steam-Jet Ejectors and Vacuum Pumps • **Boiler Feed Pumps** • **Deaerators** • **Steam Turbines** • **Surface Condensers and Auxiliaries**

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Letters to the Editors

continued from page 118

unit, pumping water into a 30-million cubic foot storage reservoir, which was used to drive a turbine generating unit as needed.

It was reported that the annual anticipated energy use was 2,300,000 kwh and while the writer has seen no further report, this method of storing energy in the form of water to be used as needed, deserves serious study as we have here a utilization which takes and reuses energy without any depletion of a natural resource. With this method, stored salt water is simply returned to its original source when used for generation.

So far as efficiency is concerned, the use of repumped water from wind energy need not be a factor but when one considers that our most efficient thermal generating units from coal pile to bus bar have a value of less than 40 per cent, the attractiveness of "pumped storage" at 60 per cent plus or completely wind-pumped energy, deserves immediate and serious consideration. — *C. O. von Dannenberg, Brooklyn, N. Y.*

Here's What They Tell Us

continued from page 6

George Neill of the City of Sibley, Iowa, after his comment that he likes POWER ENGINEERING magazine and reads it from cover to cover, continues:

> "Important to me are the superfine articles on the inside pages, and I never use the index to look for them because, in so doing, I might miss something for which I was not looking, but which frequently turns out to be most useful.
>
> "I really like your magazine, read it carefully and then pass it on with recommendations as to which articles have been of special interest to me, after I have asked for tear sheets of those which I consider to have been of vital interest."

C. H. Spink of the Federal Power Commission was an enthusiastic booster:

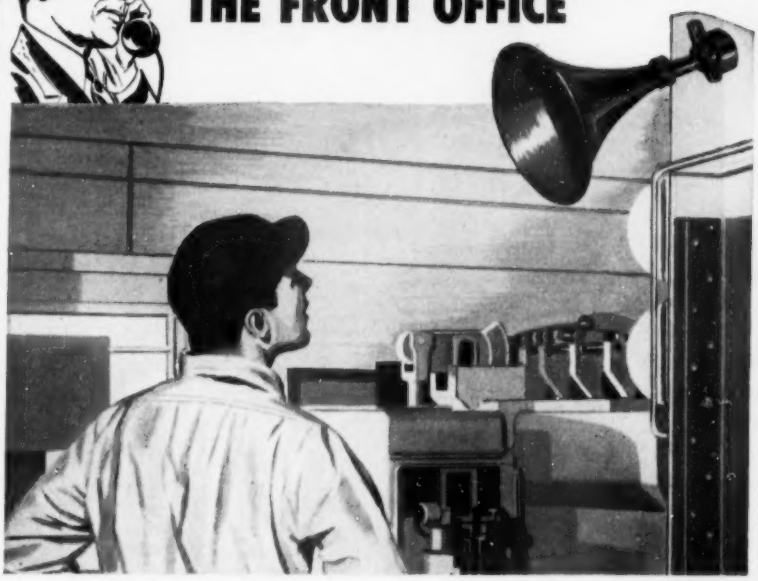
> "In opera, we would say: 'Bravo! many bravos!' That is the only way I can express my satisfaction for the many fine things about the January issue of POWER ENGINEERING. I like the format very much and the fine articles. They, in my estimation, are the way technical articles should be presented."

Another compliment from a man hard to please, **H. von Thomas,** of Bussmann Mfg.; he compliments us on the article Modern Fuses Give Wide-Range Electrical Circuit Protection, page 74 of the December issue:

> "We think you did a nice job on this article and I might say that

RCA's new idea in sound

STRAIGHT TALK FROM THE FRONT OFFICE



There's new thinking in power houses—and practically any other plant area you can name. New ideas in interior planning, new uses of color, and *new thinking in communication.*

In this power house, for example, all departments have constant contact, instant communication at any hour of the day, with an RCA Sound System.

The completely integrated sound system in this modern plant provides complete two-way communication at all these key locations: power supervisor's office . . . control room . . . turbine room . . . load dispatcher's office . . . basement and auxiliary apparatus room . . . fan and regulator room . . . and outdoor stations.

Pays its way through greater efficiency

- **Saves time in routine communications throughout the plant.**
- **Helps locate personnel fast.**
- **Forestalls emergencies and accidents.**
- **Speeds maintenance.**
- **Co-ordinates work controls.**
- **Enables existing staff to accomplish more.**

For Information on RCA Sound, mail coupon for RCA's new *Sound Products Catalog* and the new booklet *RCA Power Plant Communication Systems,* today.

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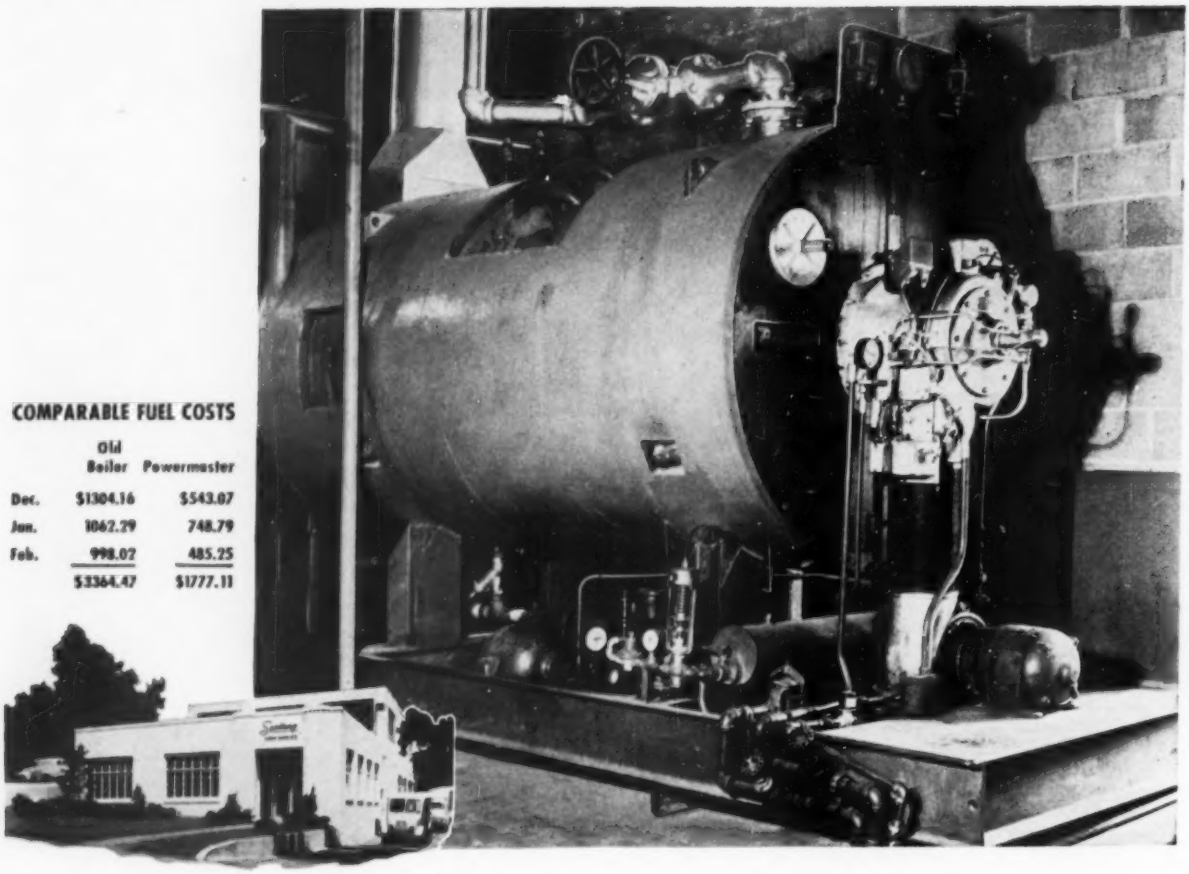
in FOOD PROCESSING PLANTS



COMPARABLE FUEL COSTS

	Old Boiler	Powermaster
Dec.	$1304.16	$543.07
Jan.	1062.29	748.79
Feb.	998.02	485.25
	$3364.47	$1777.11

Powermaster® Operating Efficiency Pays Off

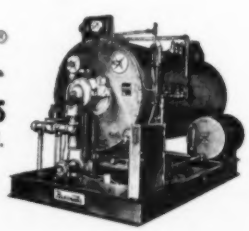
For example: An Iowa dairy cut fuel costs over 40% by replacing its original boiler with a modern oil-fired *Powermaster* a couple of years ago. And it is supplying steam for processing 150% greater volume of dairy products as well as for heating! The new boiler enabled the dairy to change to heavy oil for greater fuel economy.

Have you taken a close look at your steam costs lately? Remember, the big pay-off on a boiler is its operating efficiency . . . and that's where *Powermaster* excells, as many other dairies along with bakeries, bottlers, canners, packing houses, and other food processing plants have discovered since installing *Powermasters.* But installation, space-saving compactness, fast steaming, hospital-clean operation, maintenance-saving accessibility, and fully automatic operating and safety controls are other time-saving and cost-reducing advantages *Powermaster* provides. When you're in the market for a boiler, remember—Steam costs go down where *Powermasters* go in. Better send for latest descriptive bulletin today.

O·S *Powermaster*®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.



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Here's What They Tell Us

continued from page 121

both Labens (*J. C., Chief Engineer*) and I enjoyed your visit here."

John Valentin of the Bakelite Co., inquiring about subscriptions for his son, who has recently been promoted to application engineer with one of the larger manufacturers, says:

"It would give him (1), a good magazine, and (2), an opportunity to not only read useful articles but to become acquainted with the advertising and products of his competitors."

Charles Kottcamp, of Gulf Oil, has sent us a paper on The Gas Turbine Today and says:

"It is obviously difficult for an author from any gas turbine manufacturer to prepare a paper of this type because of the commercial delicacy of attempting to include information regarding competitive equipment. In all probability this is why I received such complete cooperation from various manufacturers in compiling these data."

H. E. Preston, the Montana-Dakota Utilities Company, tells us:

"We are installing two 4000-kw simple-cycle gas-turbine generating units in Williston. Both these units which were installed in the new addition to the existing plant have been operating since December, more or less on test. Each unit by changing nozzles is equipped to burn either natural gas or fuel oil. At present, these units are operated over the evening peak, one having run about 60 hours, the other 40 hours."

From **B. G. Hatch** of General Electric, this note:

"In the petro-chemical industry . . . one of our simple-cycle, single-shaft gas turbines, . . . is arranged to drive one low-pressure and two high-pressure compressors in tandem for a special process. . . . Waste heat from the gas turbine is recovered in a waste-heat boiler with suitable by-pass ducting, with the vertical boiler forming the base of the stack."

After reading "Qualifying Experience for the Professional Engineer's License" by John Constance) *December 1953 issue*), **Norman Stone** of Dallas, Tex., pinned a feather on the author's hat:

"If there is a similar individual as you in my vicinity, I have been unable to find him. As you probably know, someone desiring to register and prove himself qualified in my circumstances, can feel like an unwanted stepchild, there being no provisions of guidance from the various national societies, or, as far as I know in any

Where a Job Well Done JOINS HANDS...

The veteran RIC-WIL field supervisor and contractor join hands in a JOB WELL DONE. Expert field service is available on all RIC-WIL installations.

There is satisfaction in achievement . . . the knowledge that *BOTH* the supplier and the buyer have given their best . . . and the best in Prefabricated Insulated Piping for underground and overhead systems is RIC-WIL.

The next time you specify . . . specify Quality . . . specify RIC-WIL. Write direct for Catalog No. 5401 or contact your local RIC-WIL representative.

RIC-WIL Multiple Systems

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Quality Piping Systems of the . . .
. . . Highest Mechanical Strength

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY
BARBERTON, OHIO

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68 units to serve
JOPPA STEAM-ELECTRIC STATION

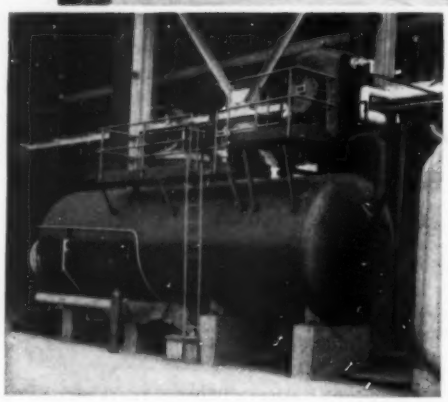
Feedwater installation by Foster Wheeler includes 12 high-pressure heaters, 34 low-pressure heaters, 18 cooling water exchangers (including make-up heaters) and 4 evaporators.

Constructed by Electric Energy, Inc. to supply approximately half of the power for AEC's Paducah Area Project, the Joppa Steam-Electric Station is designed for 937,500 KW in six boiler and turbine units. Of the semi-outdoor type, it represents one of the largest electric power stations ever planned for one building operation.

Few installations require the number of heaters which this new station will have when completed; probably none can boast of larger high-pressure heaters. The six crossover high-pressure heaters each have a surface of 7,760 sq ft capable of heating 1,162,700 lb of feedwater per hr from 411.1 F. to 470.4 when supplied with steam at a pressure of 497 psia, total temperature of 721.1 F. The six 10th-stage high-pressure heaters each have 4,858 sq ft surface. Each set is equipped with desuperheating, condensing and drain-cooling sections, and is built for handling 3200 psi, 500 F water.

The closure for these high-pressure heaters incorporates the well-known "Lockhead" feature. A patented Foster Wheeler construction, this closure provides a means for supporting the head pressure load that is separate from that for supporting the gasket compression load. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

▲ Crossover and 10th-stage feedwater heaters. Crossover heater is approximately 38' high. Shell design pressure is 550 psi at 800 F; tube design pressure 3200 psi at 500 F.



◀ Foster Wheeler evaporator with deaerating preheater. Total heating surface 3450 sq ft capable of evaporating 30,000 lbs net vapor per hr.

FOSTER WHEELER

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of the local societies. You are the first person I know of who seems to have taken an interest in this problem for which I am most grateful."

ASCE and others are giving refresher courses. Also check the book note, "Guidance Procedure for the New York Professional Engineer's License" on page 135, May issue.

Lignite Fuels 240,000-kw

continued from page 82

returns the water to the larger lake, where it cools and can be re-used.

Each of the three turbine generators at the Sandow Power Plant is set on a reinforced concrete pedestal, 18 ft above ground level. The units are tandem-compound double-flow 21-stage, with a rating of 80,000 kw. Each turbine generator is served by a 70,000-sq-ft condenser equipped with aluminum condenser tubes, first major unit to use such tubes.

Generator bus-bar is of extruded aluminum square bar, covered by a circular aluminum housing. It is connected to 8-in. exposed aluminum bus, Figs. 13 and 14, which continues to the 13.8-kv switchyard at the plant.

This switchyard consists of a double bus system, with each main bus a 12 in. by 12 in. aluminum extrusion capable of carrying 12,000 amp. Both parts of the double system are fed by each of the generating units. There are five potline feeders, fed directly from either of the main buses, to the smelting plant. In addition, there are auxiliary feeders from each of the two sections of the bus system.

There are two banks of main power transformers and regulating transformers, located between the 13.8-kv switchyard and a 138-kv switchyard. Three 138,000-v transmission-line feeders are fed from the main bus of the 138-kv switchyard. These lines connect with the Texas Power & Light Co. system, to exchange power with the Sandow Power Plant.

Power for smelting aluminum must be converted from a-c to d-c. The rectifying station, Fig. 12, does this by stepping down the 13,800-v alternating current and furnishing direct current to the smelting plant at 600 v.

Aluminum is used extensively throughout the Rockdale Works. The smelting and carbon plants use aluminum for siding, roofing, window sash, ventilators, power lines, and electrical conductors in the pot rooms. Aluminum hand rails, stairs, gratings, lighting fixtures, piping, and fencing will be found from one end of the plant to the other.

Important uses of aluminum in the Sandow Power Plant include: turbine condenser tubes, boiler casing, insulation covering, aluminum-painted surfaces, and general weatherproofing.

BIDDLE *Instrument News*

NEW PRODUCT

Biddle Motor Rotation and Phase Tester

(Dual Purpose)

With it you can

- ***Determine*** **the direction of rotation of electric motors before they are connected to the line.**
- ***Determine*** **the phase rotation or sequence of energized power circuits.**

Here is a positive means for determining which motor leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction when energized.

This device will permit the electrical contractor or industrial maintenance electrician to permanently connect and tape the terminals of the motor being installed, without having to first energize the motor by a temporary "hook-up" from a power source, if available, to determine its rotation.

The Biddle Motor Rotation and Phase Tester eliminates the need for temporary connections which can be time consuming, costly, and quite hazardous, particularly where many large high-voltage motors are involved.

Certain types of drives should not be moved even a few degrees in the wrong direction. In such cases the temporary "hook-up" or trial method, having a fifty-fifty chance of being wrong, can do serious harm.

Even in the case of new motors with tagged leads, there is the possibility of human error in attaching the lead markers or of their becoming detached in shipment.

Incidentally, there are two other important uses for this unique testing device. It can determine the polarity of power and instrument transformers, and it can be used as a continuity tester in checking electrical circuits.

Housed in a sturdy oak case 12¼ in. x 8¼ in. x 4¼ in. this compact unit weighs approximately 10 pounds and is supplied complete with 3 line and 3 motor leads which store in the compartments either side of the instrument panel.

For complete details write for ***Bulletin 80-PE***

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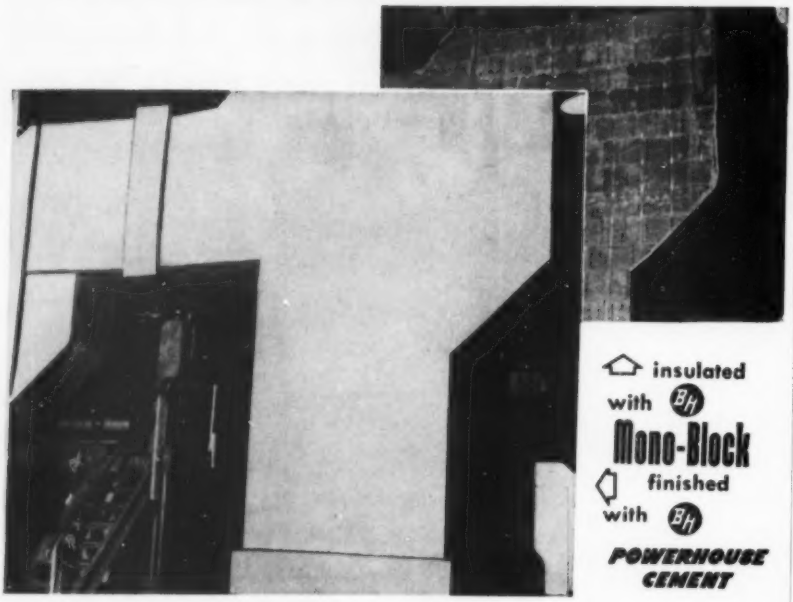

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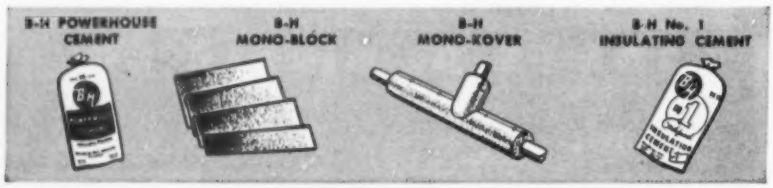

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EQUIPMENT NEWS

continued from page 54

24—BELT CONVEYOR CARRIER, low cost, has many features

The SP-745 Belt Conveyor Carrier, while low in cost, incorporates such design features as 4-in. diameter rollers which have spun ends and turn on precision ball bearings. Die cast labyrinth seals protect bearings and provide permanent protection, since they are noncorrosive, it is noted. Alemite fittings are provided for relubrication if desired, but manufacturer says enough grease is contained in bearing chamber to operate the carrier rolls on a "lubricated for life" basis.

Frames are of steel construction, and formed steel brackets and inverted angle base are designed to prevent build up of dust and dirt. Carrier rolls are interchangeable and can be inserted or removed from brackets without tools. An extended lubrication kit is available for lubrication from one side of the carrier. It comes in sizes for 18-, 24-, 30- and 36-in. belts. Stephens-Adamson Mfg. Co.

25—GLASS LENS checks liquid level of sealed valves

The Level Eye is an inexpensive device for checking inside pressure-sealed systems for liquid level, gas-liquid ratio, cleanliness of liquid and operation of sealed valves and linkages. It may be installed in tanks or piping systems operating between −50 and 250 F and at hydraulic pressures to 300 psig, with special units available for higher pressures. For very low temperature systems, a removable lucite frost shield may be added.

Basically a heat tempered glass lens with a series of concentric reflecting prisms on the liquid side of the glass, the unit reflects light where there is no liquid; liquid behind the glass causes it to appear black. This prism-type lens does not require a second lens for illumination. A transparent lens is offered in addition to the reflecting prism type. Mounting two transparent Level Eyes on opposite ends of a tank lets you see the reflection of the liquid level.

The unit consists of the lens, retainer, tubular lens mounting and compression gaskets. The housing, which has a 1½-in. glass face and mates with 1½-in. pipe, is available with male threads or with provision for welding. The Level Eye will be available on manufacturer's low and high pressure float controls for refrigerants, can be incorporated into surge drum designs. Designed for refrigeration application on valves, surge tanks, the unit can be used with most liquids, including oil. H. A. Phillips Co.

26—INSTRUMENT measures liquid level in closed tanks

A "differential converter" for measuring the level of liquids in a closed tank, either under pressure or vacuum, converts differential pressure into proportionate air pressure which, in turn,

is transmitted to indicators, recorders and controlling equipment. The instrument uses a pneumatic balance weigh-beam system, is small, and weighs 28 lb. Range is readily adjustable in field applications from 0-14 to 0-200 in. The level reading over the entire range of measurement is continuous. Available with both steel and stainless steel bodies, the unit is designed to withstand temperatures to 350 F and is rated for pressures of 750 or 1500 psi. When used with strip or circular chart recorders, it can furnish records for operation analysis, inventory checks and cost accounting purposes. Additional information is found in Bulletin 2291. Industrial Div., Minneapolis-Honeywell Regulator Co.

You may use the postage-free cards on pages 131-132 to ask for further product information. Circle item numbers of those you want to know more about. Be sure to include your job title and your company name.

27—MOTOR is more compact; better ventilated, protected

The Uniclosed Type H is a new motor conforming with NEMA specifications. By holding tolerances to closer limits and improving electrical characteristics, company has made this motor more compact than previous models. An outstanding feature announced is the drip-proof design. The frame is one-piece cast iron and the stator is pre-wound. Frame sizes 182–184 are now available.

Among new details of the motor are end brackets with air intakes so arranged as to prevent intrusion of water, yet allow liberal air flow into the motor for two-way ventilation. Baffles within air vestibules of the end brackets are designed to prevent splashings from entering and coming into contact with the windings. The asbestos-protected windings have been reinforced and strengthened by addition of Mylar laminations. Lubriflush lubrication of bearings is incorporated, and air impeller blades on the rotor ends have been redesigned for more quiet operation. According to manufacturer, the Uniclosed Type H meets same standards as its former type in temperature rise, torque, and overload capacity has not been reduced. U. S. Electrical Motors, Inc.

28—ENERGIZER helps measure voltage, current at line outlet

Two outstanding new features are incorporated in the new Amprobe Energizer Model A-40, an accessory for permitting instant current and voltage readings at the wall outlet, when used in conjunction with a snap-around voltammeter. One innovation is providing receptacles for measuring line voltage at the outlet — under actual load conditions — while the appliance is connected to the line. Another feature is heavy-duty construction which increases capacity to 25 amp for direct readings, 10 amp for 10 x sensitivity readings.

The Energizer can serve as a "split" plug to divide double-conductor line cords at the outlet for a quick snap-around ammeter reading; and it can

Reliance EYE-HYE can now operate auxiliary alarms

FOR extra safety, you can now place light signals or horns at a distance from your Reliance EYE-HYE and have multiple warnings as accurate as the EYE-HYE indication itself.

Electrodes extending into the window unit and calibrating tube complete an electrical circuit at the level of the indicating fluid. A special transformer-relay unit supplies current on an isolated circuit that assures positive, accurate action when boiler water level reaches predetermined low or high level points. The signals or alarms coincide exactly with the reading in the always accurate EYE-HYE.

Two-light or three-light indicators, and/or vibratory horns may be used for the extra away-from-the-board warnings. Increase the safety of your water level control. Write for Bulletin C6 describing EYE-HYE with auxiliary alarms.

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increase split-core ammeter sensitivity by 10 times for precise readings on fhp motors. The Amprobe Energizer costs around $3.50. Pyramid Instrument Corp.

29—D-C AMPLIFIER has long and short term stability

The new Series 80 D-C Amplifiers convert low level d-c microampere or millivolt inputs to a high level d-c current output. Incorporating a high gain feed back loop, the amplifier has exceptional long and short term stability characterization, says manufacturer. Suitable for many applications involving measurement or recording of low level d-c signals, it can also be used as a thermocouple amplifier. It can be used as a constant current source in conjunction with a standard cell. Of the null balance type, the amplifiers have extremely high input impedance when used with voltage inputs, drawing no current from the source. Where the input is current, the input impedance is negligible. Ranges extend from 5 microvolts and 20 microamps full scale, and output is 5 milliamps full scale. Fielden Instrument Div., Robertshaw-Fulton Controls.

30—PRESSURE TRANSMITTER for measuring gas, liquids

The Model 6100F pressure transmitter is announced for use with pneumatically-operated instruments in measuring pressure of liquids and gases, or the depth, weight or volume of liquids, in vented and pressurized tanks. It is designed to provide a positive seal between the gaging system and fluids, and can be used

with many fluids, including some which are dangerous or difficult to measure. The unit's diaphragm is exposed to the fluid to be measured, it is explained, the pressure of the fluid on the outer side of the diaphragm being continuously balanced by the pressure of the air on the inner side. This pressure is transmitted through a tube to the receiver. The air in the pressure transmitter has no contact with the fluid measured.

Two or more receivers, of various types, can be used with the same transmitter. Essentially a 1-to-1 transmitter, it has linear response from ½ in. water upward. More data is given in Catalog 4000. King Engineering Corp.

31—SPROCKETS are available in larger pitch sizes

Extension of this company's "off-the-shelf" line of Taper-Lock sprockets to include the 1½-in., 1¾-in. and 2-in. pitch sizes is announced. This means that users of single strand roller chain will now be able to secure sprockets and

bushings for chain sizes from 40 through 160 direct from distributors' shelves ready for immediate installation. Generally, this sprocket complete with bushing costs less than a comparable sprocket bored to shaft size, manufacturer claims. All sprockets in the new larger pitches, up through the 26-tooth size, will be made of high carbon steel and can be hardened. Larger sprockets will be available in close-grained semi-steel. More information is available in a new bulletin supplement. Dodge Mfg. Co.

32—WATTHOUR METER, 50-amp, of greater load range

A 50-amp, single-phase watthour meter of improved design and straight-line accuracy up to 200 amp has been added to this manufacturer's I-50 line. It is announced as having a load range more than three times that of the standard 15-amp meter, with no increase in external dimensions. General Electric Co.

33—TEMPLATE with fundamental power and light symbols

The No. 62 Power and Light Template, size 7¾ by 5¾ in., contains fundamental symbols to portray component parts or elements. Combinations can be made to depict electrical devices and variations of general items. The No. 62 is made of 0.060 mathematical plastic, and center lines are scribed on the bottom of the template for elimination of parallax error and permanence. This template is priced around $5.00. Rapidesign, Inc.

34—INDICATOR VALVE has new type seating element

A new engine indicator valve uses a free-floating nickel-alloy ball as the seating element. The ball is forced into a conical seat by the engine pressure when the valve is closed, and in this position, the valve spindle is backed away from the ball and shielded from the direct flame of combustion. This is designed to prevent galling of threads and sticking of the spindle in the gland. The valve is opened by one turn of the handwheel, causing the spindle to move inward and force the ball off its seat.

This design makes possible opening and closing the valve by hand pressure, manufacturer says, and it assures tight closure under all operating conditions — of importance on gas engines and compressors, where accidental opening of an indicator valve could result in hazardous conditions. The valve does not have to be removed from the engine for replacing any of its parts. Bacharach Industrial Instrument Co.

35—PAINT REMOVER is low-cost radiant-heat type

Besides removing paint, varnish and other finishes from wood, metal and brick surfaces, this product has many other uses — including thawing frozen pipes. It consists of a Calrod heating element mounted on steel runners that keep it a safe distance from working surfaces. Twin galvanized steel plates under the wood handle serve to protect the operator's hand from the heat.

Weighing only 2¼ lb, the unit is described as almost effortless to use vertically or horizontally. Rated at 1000 w, 115 v, it is ready for operation within a few minutes after being plugged in. It comes equipped with a 6 ft cord, sells for around $12.00. General Electric Co.

DO YOU USE OR MAKE ANY OF THE PRODUCTS IN THIS LISTING?

List of Users

The types of industries listed are all repeat users of **Tru-Lay Push-Pull Controls.** Experimental applications are not shown.

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Bakery Equipment Boats & Ships
Bottling Machinery
Brewing & Distilling Equipment
Business Machines
Buses & Motor Trucks
Candy Making Machinery
Canning Machinery
Ceramics Machinery
Chemical Processing Machinery
Coal Mining Machinery
Coin Operated Machines
Construction Machinery
Dairy Products Machinery
Dental & Surgical Equipment
Die Casting Machinery Diesel Engines
Drinking Water Coolers
Electrical Appliances
Electrical Generating Equipment
Electrical Machinery
Electrical Transmitting Equipment
Electronic Equipment
Elevator Control Panels
Fire Protection Equipment
Food Processing Equipment
Forging Machinery
Foundry Equipment
Gas & Oil Production (Test Stands)
Glass Making Machinery
Grain Processing Equipment
Hat Machinery Heating Equipment
Hydraulic & Pneumatic Equipment
Ice Cream Making Machinery
Laundry & Dry Cleaning Equipment
Leather Working Machinery
Lumber & Saw Mill Machinery
Marine Equipment
Materials Handling Equipment
Metal Mining Machinery
Metal Working Machinery—Machine Tools
Military & Naval Equipment
Motorcycles & Bicycles
Nuclear Science Equipment
Oil Refinery Equipment Ordnance
Packaging Machinery
Paint Making Machinery
Paper Making Machinery
Photo Equipment (manufacture)
Plastics Fabricating Machinery
Plastics Producing Machinery
Power Plant Equipment
Printing & Binding Machinery
Quarrying Machinery
Radio & Television (manufacture)
Railroad Equipment
Road Building & Maintenance Equipment
Rubber Processing Equipment
Safety Locks on Fuse Panels
Sanitation Plumbing (Floor Valves)
Shoe Machinery Steel Mill Machinery
Telephone & Telegraph Machinery
Textile Machinery
Waterworks Equipment
Welding Equipment
Wire Making Machinery
Woodworking Equipment
X-Ray Machines

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PUSH-PULL CONTROL

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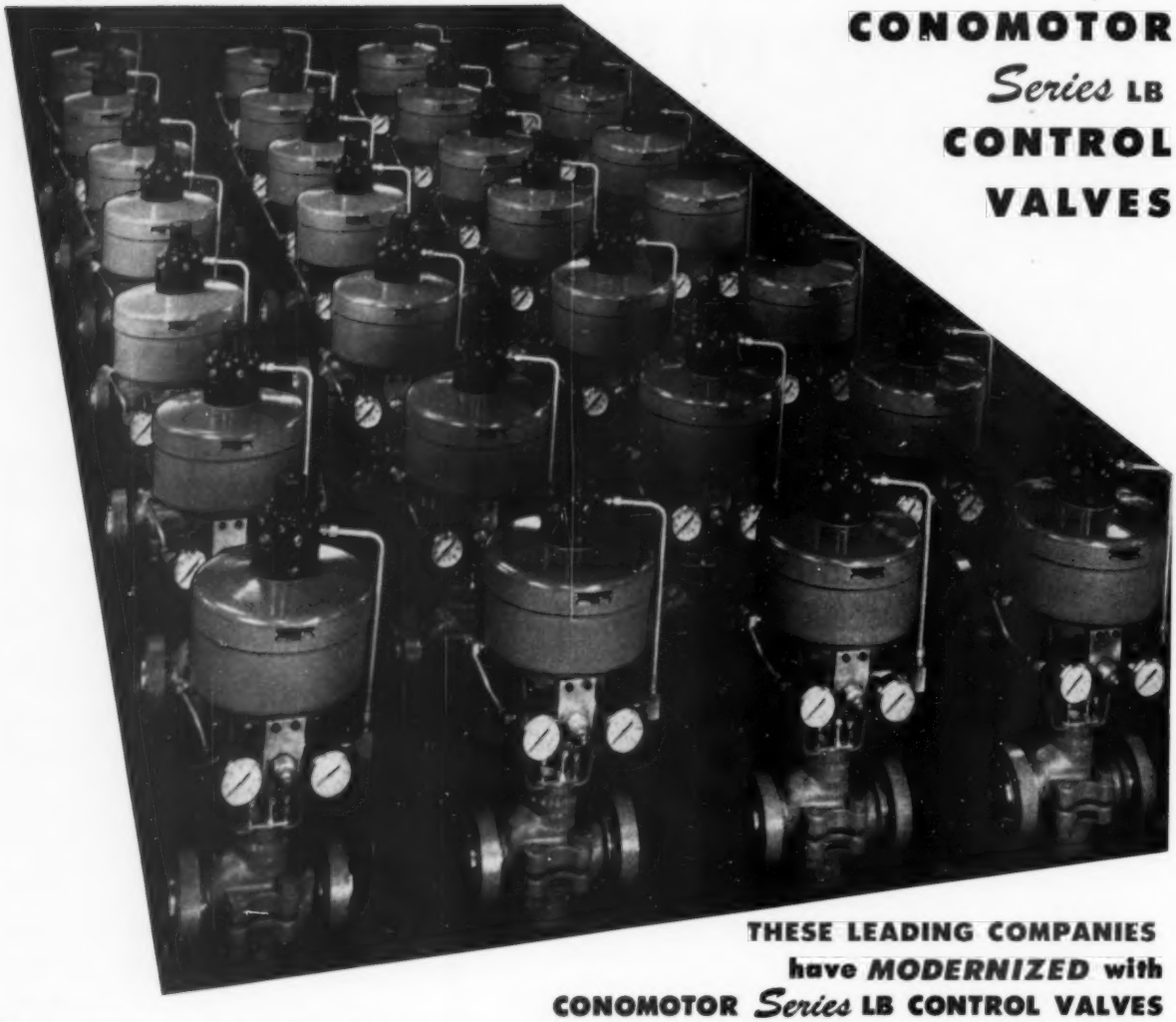

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- Bakelite Company
- Colgate-Palmolive Co.
- Curtiss-Wright Corp.
- E. I. du Pont de Nemours & Co., Inc.
- Emery Industries, Inc.
- General Electric Co.
- Heyden Chemical Corp.
- Naugatuck Chemical Division U. S. Rubber Co.
- Philadelphia Electric Co.
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Standard catalogs listed monthly to help you maintain a reference library

VALVES, TRAPS, PIPING AND ACCESSORIES

201 **Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

202 **Safety Valve Engineering Data** — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

203 **Solenoid Operated Valve** — Eight-pp Technical Bulletin W-7 describes solenoid operated valves which automatically open or close in response to time clock, pressure switch, manual switch or other impulse. Contains operating instructions, illustrated parts lists, and dimensions for these valves, used in steel, processing, pulp and paper mills, rubber and chemical plants, and water works. Golden-Anderson Valve Specialty Co.

204 **General Service Valves** — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

It's easy to get these free catalogs—just circle item numbers of those wanted on post card at right. Use the card, also, to ask for further information on the advertised products.

205 **For Quick Valve Selection** — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

206 **Regulating Valves** — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

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208 Pump Valves — Sixteen-pp Catalog SC-510, now available to power engineers, describes and illustrates valves made to fit practically all makes of reciprocating pumps. Key features of the valves are discussed, and standard, lock-in and deck types are covered in detail. Sims Pump Valve Co., Inc.

209 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

210 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

211 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

212 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

213 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

214 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

215 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring.

216 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam

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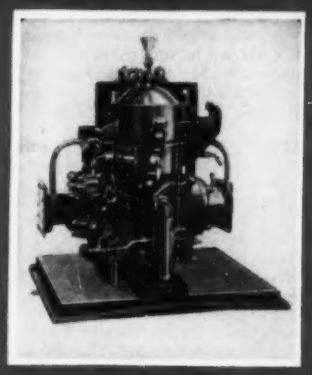

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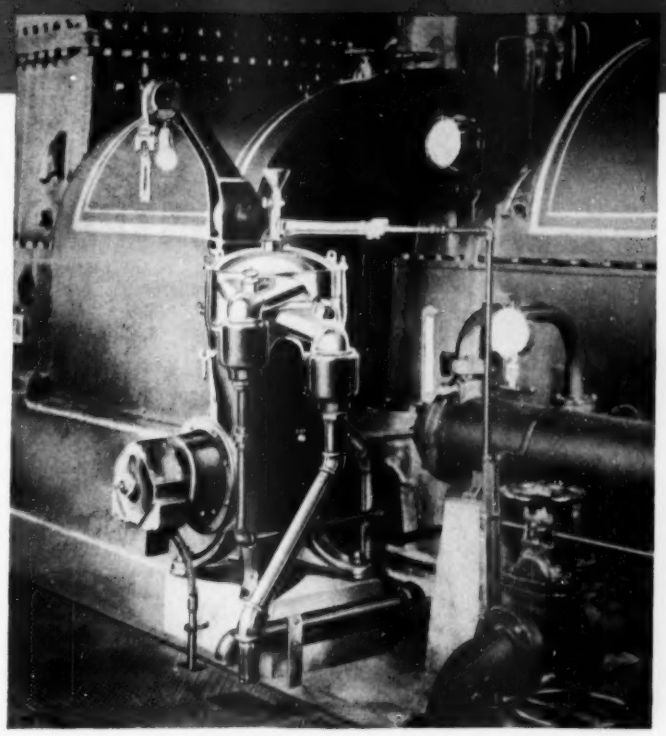

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That is why De Laval Purifiers measure up in the highest degree, to the exacting requirements of turbine service.

They clean the oil *thoroughly*—removing dirt, sludge *and water*—giving complete protection . . .

They *stand up* in service, giving this complete protection *continuously*—24-hour per day dependability, day after day, month after month, year after year.

Complete protection plus continuous protection is maximum protection—DE LAVAL PROTECTION . . . the only kind you should have for your turbines—ashore or afloat.

Write for De Laval Technical Bulletin on Turbine Oil Purification—TU-1.

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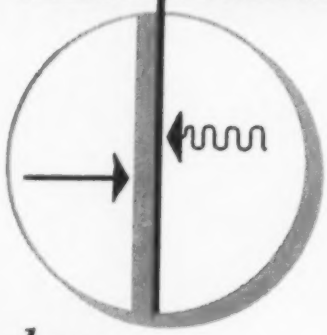

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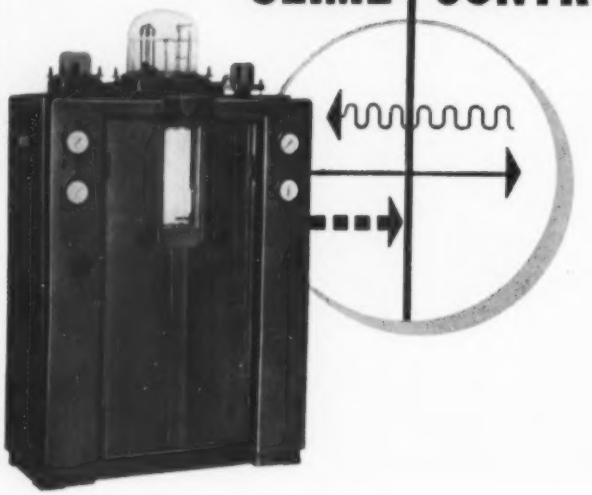

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traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

217 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

218 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

219 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

220 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

221 Pipe Insulation — Mono-Kover, a lightweight one-piece pipe insulation, is described in this bulletin. Photos show how easily it is applied, and text covers its thermal resistance, permanence, resiliency, non-corrosive properties and lower applied cost. Also included are a thermal efficiency chart, insulation thickness selection table, and information on sizes and thicknesses available. Baldwin-Hill Co.

ELECTRICAL

222 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and dimensions. Allis-Chalmers Mfg. Co.

223 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors is given. Westinghouse Electric Corp.

224 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords.

A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

225 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

226 Motor Lubrication — Three methods of lubricating electric motors — cartridge, standard open and company's Lubriflush — are compared in 8-pp Bulletin 1848. To demonstrate action of relubrication in Lubriflush bearings, a series of natural color photos of a transparent bearing housing is reproduced. Necessity of annual lubrication is demonstrated photographically. U. S. Electrical Motors Inc.

227 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Explains how high speed operation on heavy shorts limits current to safe values; how fuse minimizes equipment damage, reduces dangerous stresses in transformers, and protects inadequate circuit breakers. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

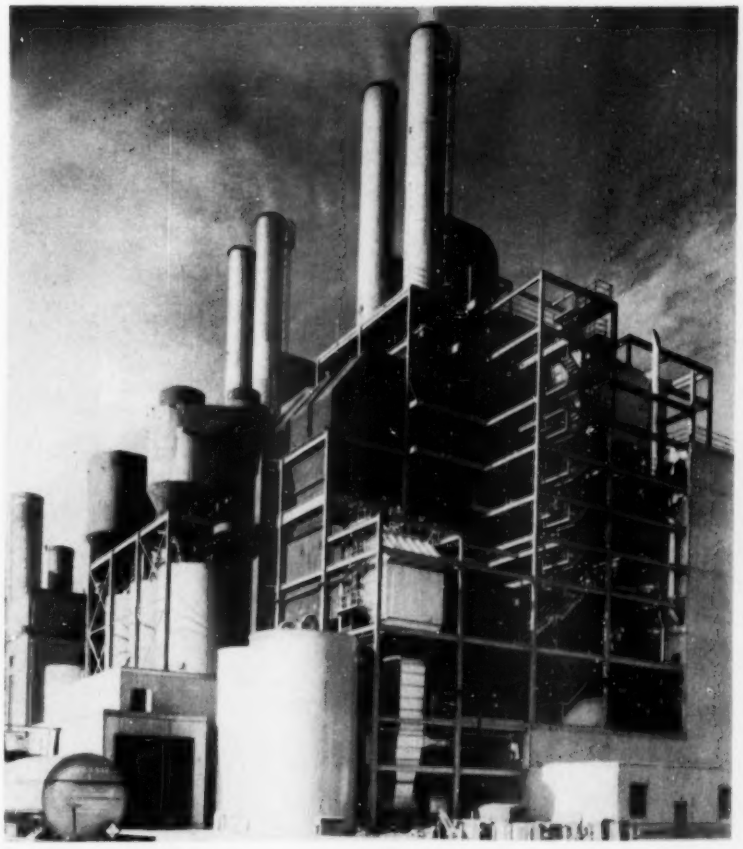
228 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

229 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

PUMPS, PUMPING

230 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

231 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.



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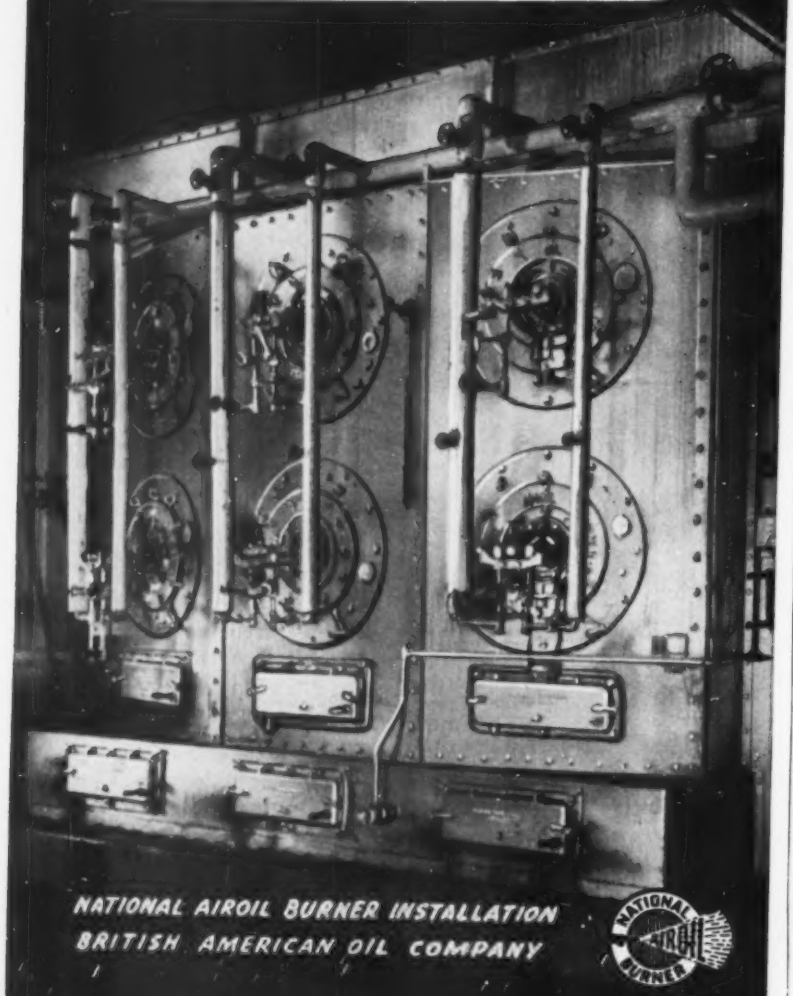

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232 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suitable for use with some 170 industrial fluids. Milton Roy Co.

233 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

INSTRUMENTS AND CONTROLS

234 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation" consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation are discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

235 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

236 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

237 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

239 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

240 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler

water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

241 Steam Calorimeter — This bulletin discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of unit. Ellison Draft Gage Co., Inc.

WATER CONDITIONING

242 Handbook on Demineralizing — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multistage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

243 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

244 Water Conditioning Data Book — This pocket-size 116-pp booklet presents 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

245 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

246 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

247 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

248 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler

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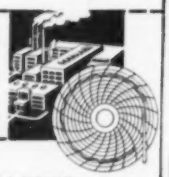

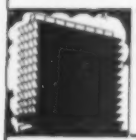

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water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

249 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

MATERIALS HANDLING

250 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

251 Conveying Systems — How this manufacturer's conveying systems are being used in handling dry pulverized and granular materials is shown in illustrated Bulletin FK-26, 16 pp. Types of systems and component parts are described and typical installations are pictured, including conveying and unloading applications in several industries. Fuller Co.

BOILERS, GENERATORS

252 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions of the boilers are given. The Babcock & Wilcox Co.

253 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

254 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

255 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

256 Automatic Boilers — This bulletin describes 17 sizes of Powermaster packaged automatic boilers from 15 through 500 hp for steam process, steam and hot water heating service. Lists such

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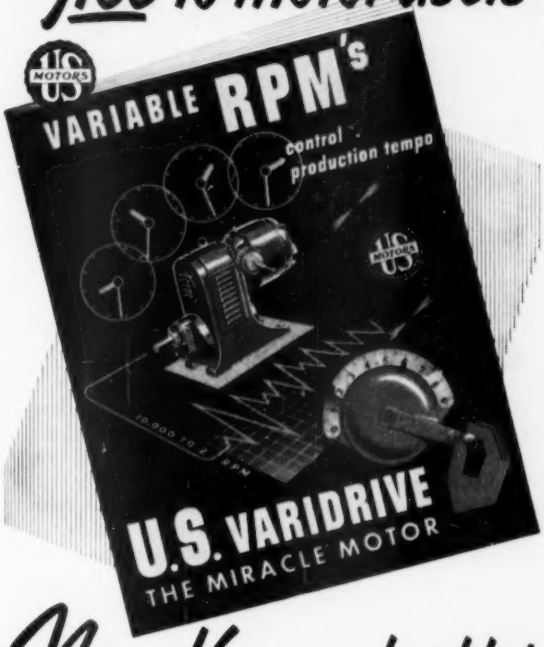

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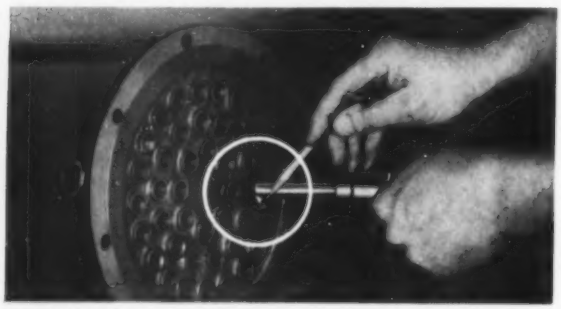

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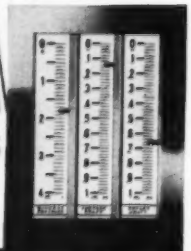

1910
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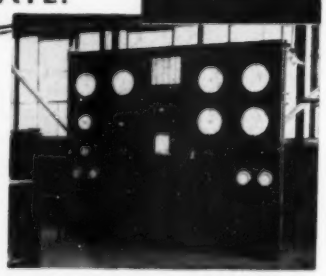

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advantages as three-pass design, forced draft and automatic controls. Describes firing equipment for light and heavy oils, gas; shows various fuel firing arrangements. Orr & Sembower, Inc.

257 Water-Tube Package Boilers — This bulletin describes and illustrates company's Type H water tube package units. Advantages of the boiler are listed. Also included are dimension drawings and a table of capacities, sizes and weights for ten standard sizes from 8000 to 30,000 lb of steam per hour. The Bigelow Co.

BURNING EQUIPMENT

258 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

259 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

260 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

TUBING AND ACCESSORIES

261 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are given. Scovill Mfg. Co.

262 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

263 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

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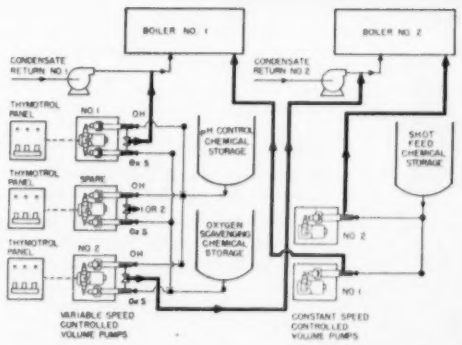

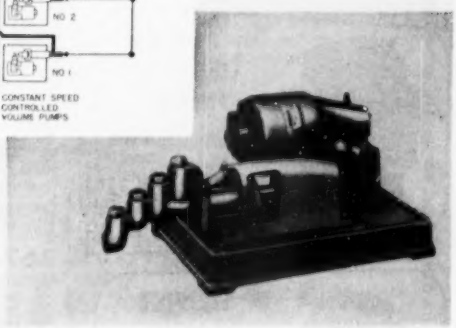

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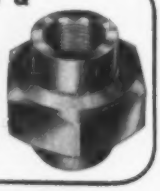

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264 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

265 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described and pictured, and a wide range of miscellaneous equipment is shown. Thomas C. Wilson, Inc.

Postage-free cards for ordering catalogs are on pages 131-132. You may also use the cards to ask for further information on the advertised products.

266 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

267 Data on Stress Values — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

COAL, ASH HANDLING

268 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

269 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

270 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Also describes CMP units which combine in a single installation the ad-

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vantages of the Multiclone cyclonic tube with the Cottrell electrostatic precipitator. Western Precipitation Corp.

271 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

272 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are also included. Beaumont Birch Co.

273 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

FUEL OILS, LUBRICANTS

274 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. A chart shows relation of engine performance to fuel properties. Sinclair Refining Co.

275 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

276 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

277 Compressor Lubrication Problems — Vol. 40, No. 1 of Lubrication provides a 14-pp article on problems associated with compressor lubrication. Reviews compressor types, function of the lubricant and importance of adequate installation. Air compressor explosions and receiver fires are discussed, as are condensation and compressor cooling, bearing lubrication, selection of lubrications. Special problems of air, gas, refrigerator, and other compressors are treated. Includes lists of factors which control dependable compressor operation; those which may react against efficiency. The Texas Co.

278 Air Compressor Lubrication Manual — Valuable information on air

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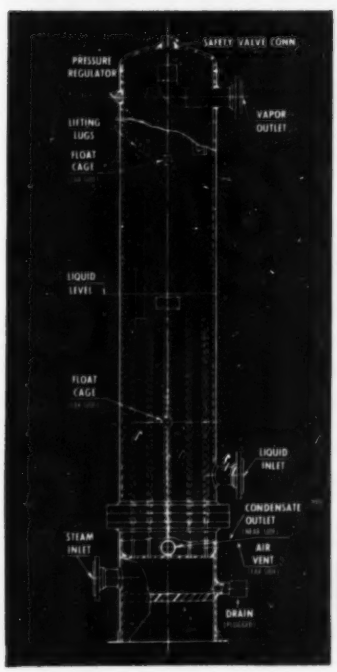

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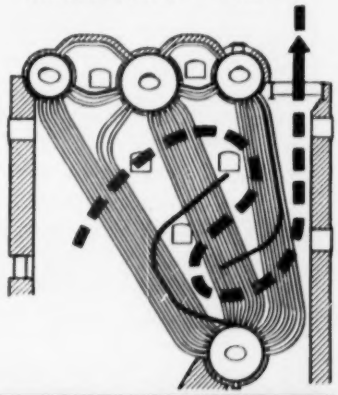

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compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

280 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

281 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

OTHER EQUIPMENT

284 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Dimensions and weights of standard units tabulated. Elliott Co.

285 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

286 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

287 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for large and small condensers. Henry Vogt Machine Co.

288 Specialized Scale Removal — This bulletin explains company's method of removing scale from water and gas lines with liquid cleaning solvents. Cites cleaning of oil refinery's waterlines in 38 hours with minimum service interruption, and without need of digging up buried lines. Dowell Inc.

290 Dry Ice Converters — This illustrated bulletin describes pressure vessels with removable closures into which dry ice is charged and in which the resulting carbon dioxide is stored indefinitely under pressure. Gives advantages of CO_2 for purging or use as an inert gas, and advantages of the dry ice converters as a source of CO_2. Includes installation suggestions. Dry Ice Converter Co.

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291 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

294 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

295 Induced Draft Fans — Manufacturer's induced draft Bifucator fans, said to provide controlled draft for boilers and furnaces at all times, are the subject of this Bulletin DB-32-53. Illustrations, specifications and dimensions of these fans in sizes for both high pressure and low pressure boilers are provided. DeBothezat Fans Div., American Machine and Metals, Inc.

296 To Cut Boiler Plant Costs — Savings in plant fuel and labor costs by use of continuous boiler blowoff heat recovery equipment is discussed in 8-pp Bulletin WC-114. Two pages of charts, curves and calculations show how to compute savings in Btu per year. Flow diagrams illustrate such type systems as flash and non-flash, single and double flash tank, and combination flash-deaerator. Graver Water Conditioning Co.

297 Communication Systems — Sixteen-pp Form P831 presents communication systems engineered for power plants. Advantages of such a system are given and photos show it in use in turbine rooms, boiler rooms, control rooms, laboratories and outdoors. Amplifiers, handsets, speakers, wall baffles, signal lights, switches and master control equipment incorporated are covered. RCA Victor Div., Radio Corp. of America.

298 Industrial Products Guide — Newest edition of this company's industrial products catalog is a 40-pp book offering essential data on insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, and others. Photos, diagrams, and text have been brought up to date. Johns-Manville.

299 Automatic Soot Blowing — Bulletin 483 provides 16 pp of basic information about Vulcan automatic and automatic-sequential soot blowing. Includes a wide variety of typical installation drawings to show complete cleaning systems. Copes-Vulcan Div., Continental Foundry & Machine Co.

300 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

301 Industrial Equipment — Bulletin WP-1099-B61, 16 pp, describes manufacturer's industrial equipment including centrifugal refrigeration, condensers and coolers, steam power plant equipment, water conditioning deaerators and rotary pumps. Gives features, types, sizes, capacities. Worthington Corp.

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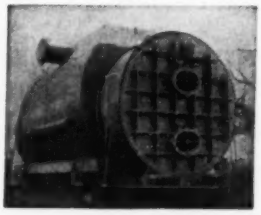

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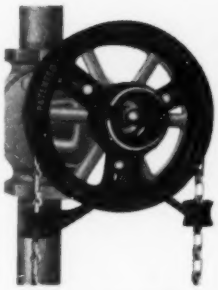
Play It Safe with . . .

Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

Avoid accidents and costly claims against your company! Operate overhead valves direct from the floor — without ladder climbing, balancing on boilers, standing on workbenches and machines or other risky perches.



Check these outstanding advantages of Babbitt Adjustable Sprocket Rim with Chain Guide:

- **Cuts fuel & steam waste**
- **Fits all valve wheels**
- **Prevents accidents**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems. Only four simple parts, quickly-assembled, quickly installed.

Call your Industrial Distributor. He carries complete stocks.
Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS

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GAUGE JITTERS PREVENTED

with CAMPBELL

MICRO BEAN

Jitters are destructive — Micro-Bean protects gauge

A UNIVERSAL PULSATION DAMPENER

Solve pulsation problems on gauge and governor lines. Micro-Bean instantly adjusts to compensate in viscosity and surface tension. Will not score out. Jitters in gauges positively eliminated. Any line subjected to pulsation flow can be stabilized with Micro-Bean. Will multiply life of gauges by ten. Demanded by hundreds of engineers. More than 8000 used in World War II on portable fuel and water lines. An absolute necessity in many power plants. Can be used on any gauge line to boilers, engines, pumps and compressors. ¼" and ½", pressures to 10,000 lb. Write for literature and prices.

J. A. CAMPBELL CO.

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The Most Experienced Power Plant Operators

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Blaw-Knox Company is the foremost expert in designing clamshell buckets for handling coal or coke.

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Ask for Bulletin 2229.

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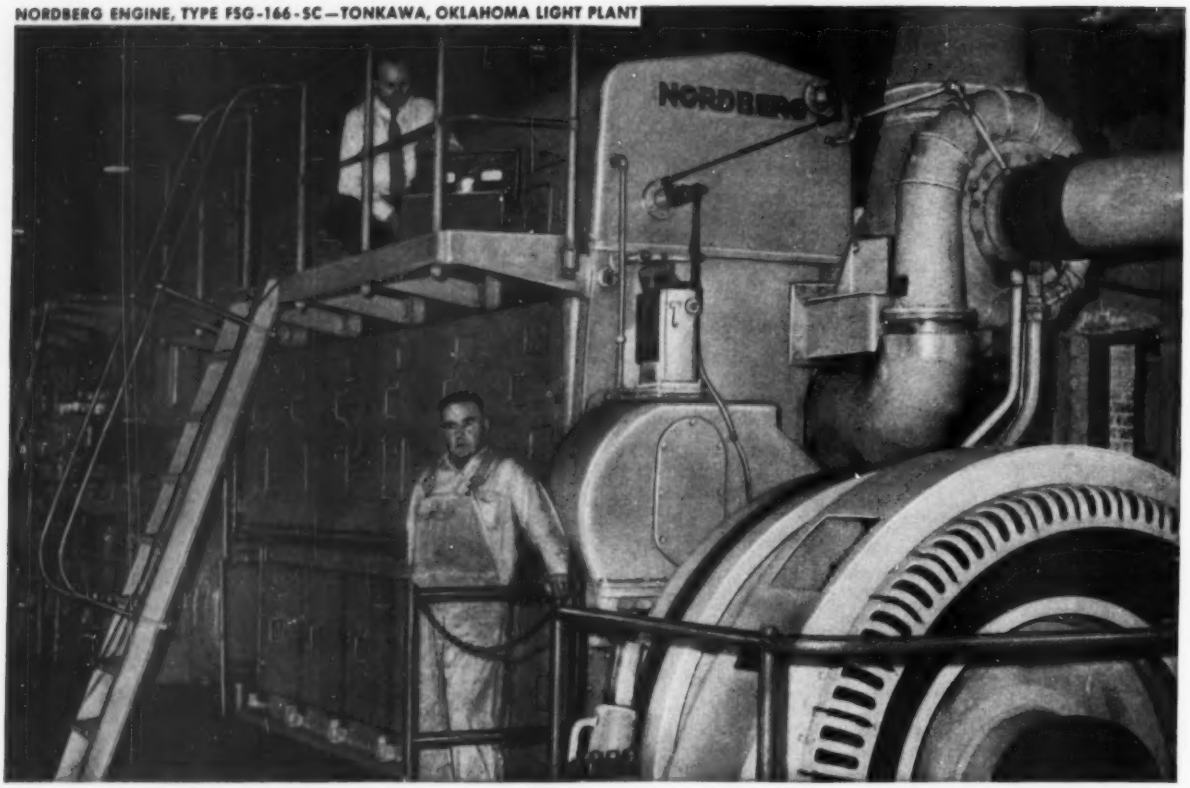
NORDBERG ENGINE, TYPE FSG-166-SC—TONKAWA, OKLAHOMA LIGHT PLANT



30,000 HOURS, NO WEAR!

MICROMETER MEASUREMENTS			
LINER MEASUREMENTS		WITH CRANK	90° TO CRANK
#1 Liner	Top	16.004"	16.008"
	4" down	.003"	.006"
	8" down	.0035"	.007"
#2 Liner	Top	16.003"	16.002"
	4" down	.002"	.001"
	8" down	.001"	.0005"
#3 Liner	Top	16.005"	16.007"
	4" down	.004"	.006"
	8" down	.003"	.008"
#4 Liner	Top	16.003"	16.004"
	4" down	.004"	.005"
	8" down	.001"	.002"
#5 Liner	Top	16.004"	16.000"
	4" down	.003"	.000"
	8" down	.003"	.001"
#6 Liner	Top	16.003"	16.0015"
	4" down	.0015"	.0015"
	8" down	.0015"	.0005"
(Original machine shop tolerance—16" plus or minus .001")			

No Wear On Rings Or Liners With Great Cities Service Diesel Oils!

When the Tonkawa City people pulled this Diesel off the line for periodical inspection, it had logged 30,038 hours and was approximately six years old. After they had the engine torn down, micrometer measurements were taken on the cylinder liners. THEY COULD FIND VIRTUALLY NO APPRECIABLE WEAR ON RINGS OR LINERS!

They were so amazed that they had another man in the plant take his own micrometer readings. Still not certain that an engine could run that long with so little wear, they had the micrometer itself checked! The instrument checked out perfectly!

Men who have worked with Diesel Engines all their lives have said that they've never seen an engine with that much time in service with so little wear. Obviously, a great deal of the credit must go to the maker of these splendid engines, but also, credit must be given to the high-quality, wear-reducing Cities Service Diesel Oils used in this engine. You'd be wise to buy yourself this kind of inexpensive diesel-engine protection too. Call your nearest Cities Service Office or write Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

CITIES SERVICE
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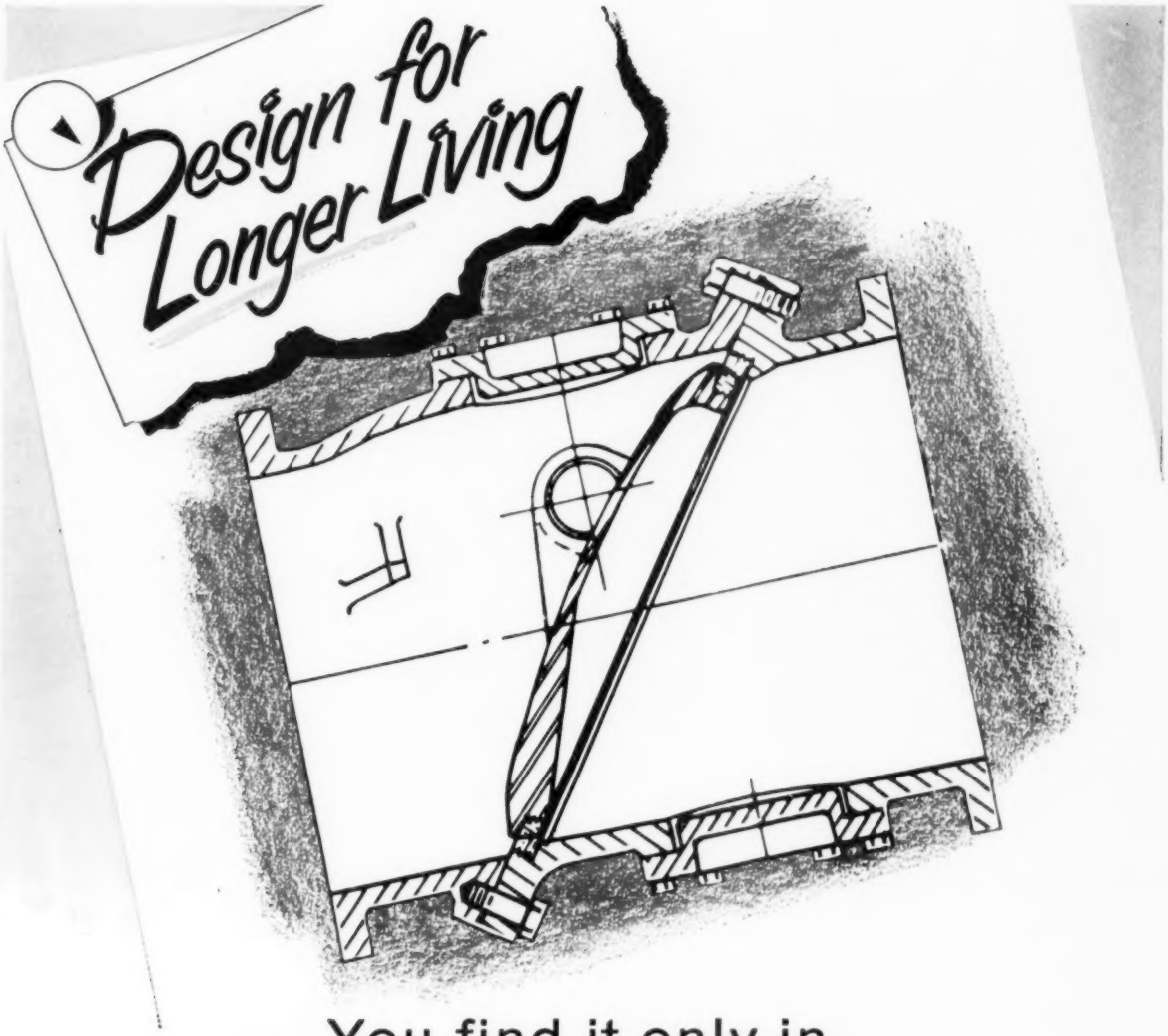
Design for Longer Living



...You find it only in

CHAPMAN'S

Tilting Disc CHECK VALVE

Here you can see the specially designed *airfoil section* of the disc in the Chapman Tilting Disc Check Valve . . . and you can see how the disc-seat lifts away from the body seat when opening (and drops into contact when closing) with no *sliding or wearing of the seats.*

Under usual piping arrangements this unique designed disc won't slam . . . just cushions itself to a quiet closing that does not even jar the line.

And this balancing is the reason why Chapman Tilting Disc Check Valves greatly reduce head-loss over standard designed swing-type checks . . . as proven by tests in leading engineering schools and by actual performance in the field.

Available in iron or steel. Complete test data is given in Catalog No. 30—write for your copy now.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

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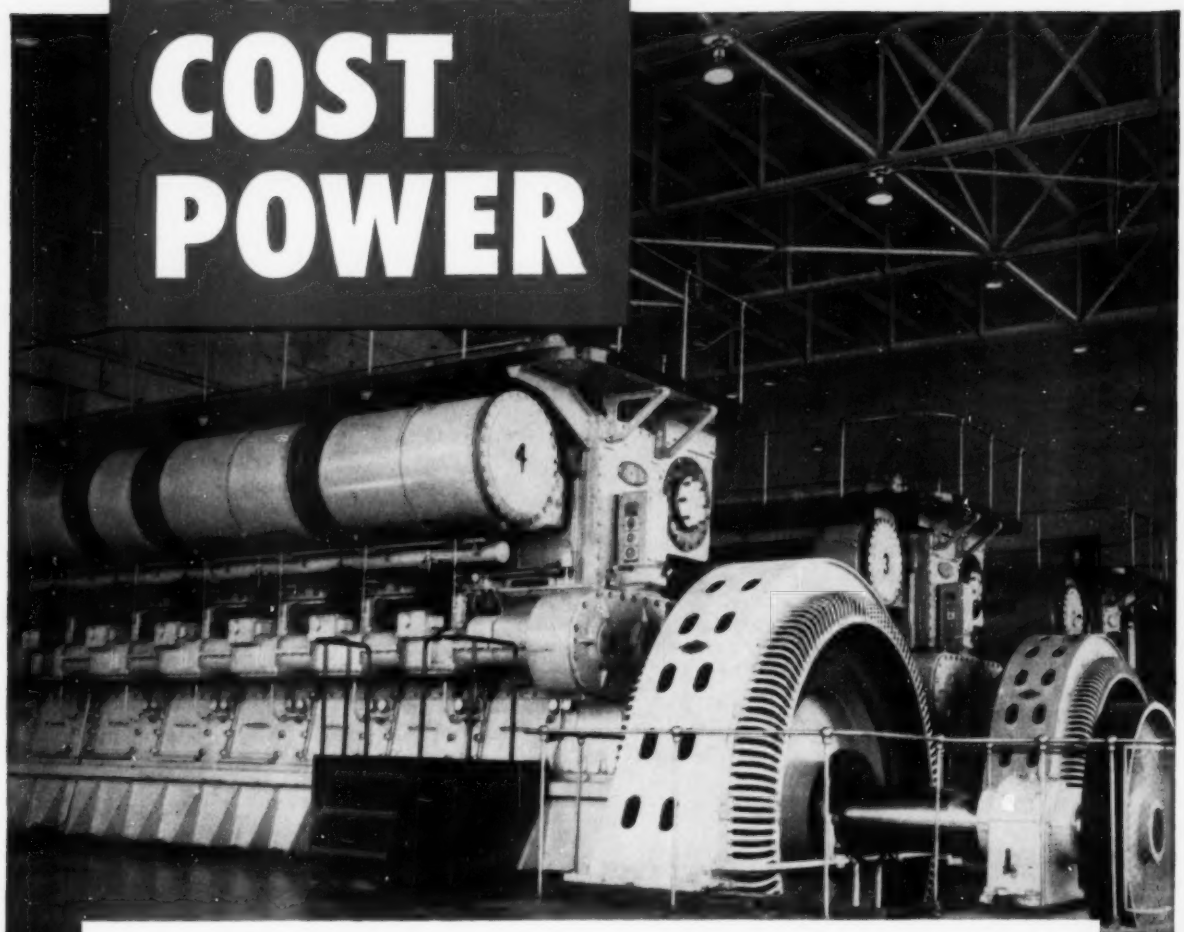
LOWER COST POWER



HERE'S HOW you can reduce your diesel maintenance costs and cut your fuel consumption: Lubricate with one of the famous *Texaco Ursa Oil* series—the one that's exactly right for your engines and operating conditions.

The *Texaco Ursa Oil* series is a complete line of lubricating oils especially refined to make diesel, gas and dual-fuel engines deliver *more power* with *less fuel* over *longer periods* between overhauls.

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For over 20 years, more stationary diesel horsepower in the U. S. has been lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer will gladly help you select the proper oils to give you maximum efficiency at lowest possible cost. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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TEXACO

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FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

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